A window open on the world

The UNESCO Courier

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THE EMERGENCE OF MAN

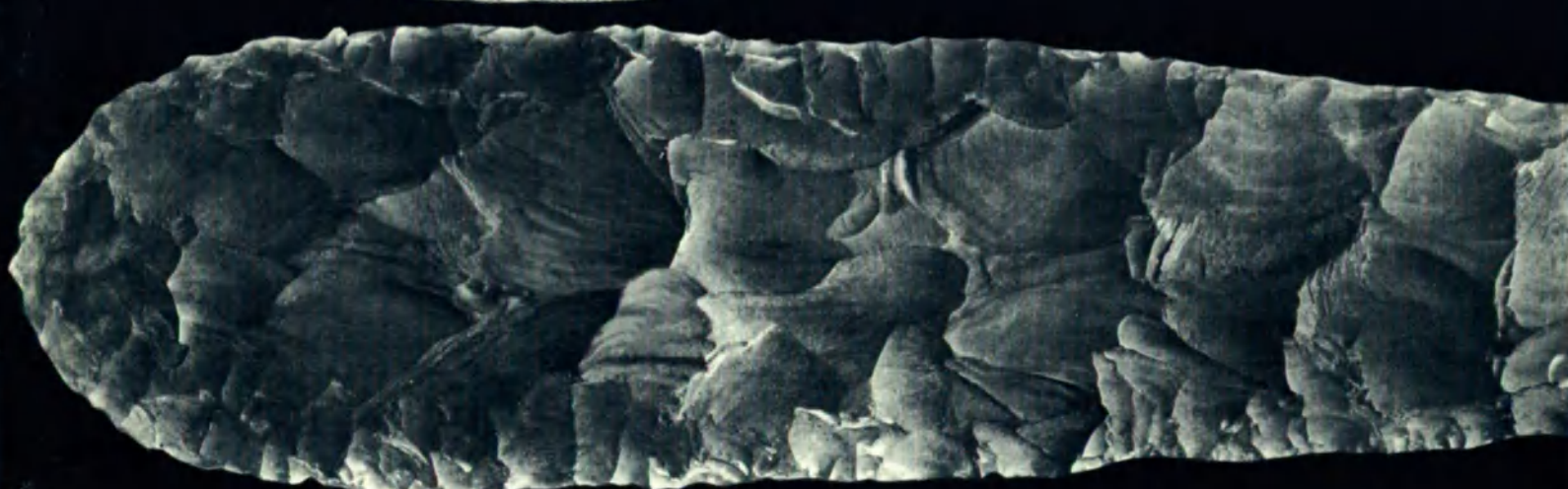

Photo © Musée des Antiquités Nationales, Saint-Germain-en-Laye

Lady of Brassempouy

This woman's head in ivory is one of the oldest sculptured reproductions of the human face. Named "The Lady of Brassempouy", from the site of the cave in south-west France where it was discovered, this remarkable example of Perigordian culture dates back to between 20,000 and 25,000 B.C. Men rarely figure in Palaeolithic art and even in cave paintings are usually depicted as stick-figures (see back cover) or covered with animal robes. "The Lady of Brassempouy" is now in the Museum of National Antiquities, at Saint-Germain-en-Laye, near Paris. (See also p. 33.)

The UNESCO Courier

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1972 International Book Year

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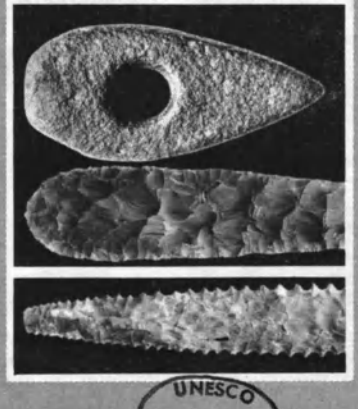


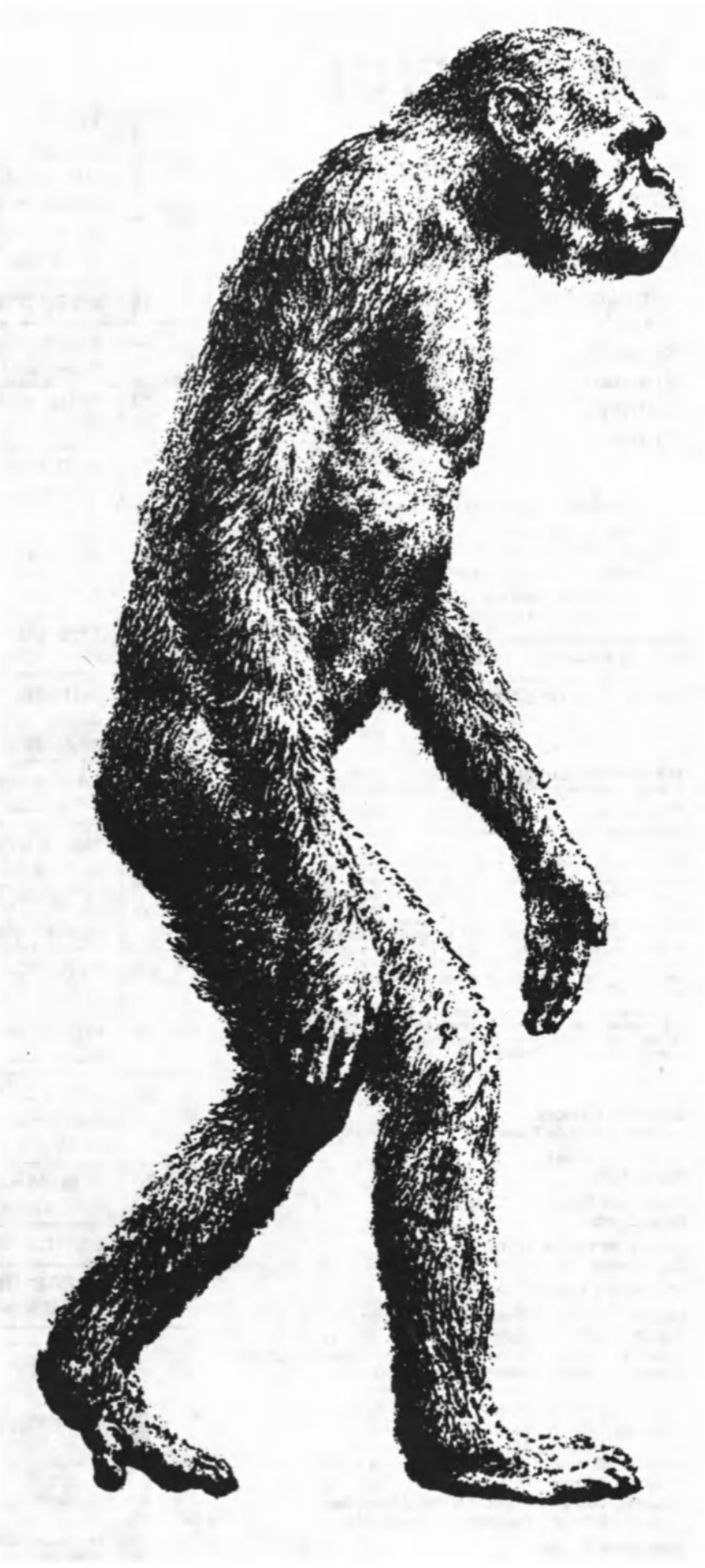
THE EMERGENCE OF MAN

In the long progression towards Homo sapiens, man's ancestors learned to make and use different tools. Millions of such tools are testimony to early man's skill and craftsmanship where the marriage of function and design often gave birth to objects of great beauty. Cover shows three examples from the Palaeolithic and Neolithic periods: top an axehead; centre a laurel-leaf spearhead; bottom, a tooth-edged blade.

Photo © IBM, Paris

UNESCO ARCHIVES

THIS issue is devoted to a question which has aroused passionate argument and debate for many years: The Origin of Man. Recent research has provided new answers to many puzzling aspects of this question. A few years ago, Unesco convened an international symposium on the subject in collaboration with the International Union for Quaternary Research. The proceedings have now been published under the title "The Origin of Homo sapiens", produced for the specialist (see bibliography inside back cover). For this special issue, the editors of the "Unesco Courier" have called upon some of the leading authorities in the field of palaeontology to trace the story of man's origins in simple language accessible to the layman. It is the editors' hope that the texts and illustrations will help to make all readers more familiar with man's past and the long road that has been travelled since the 19th century refused to believe that modern man ever had any primitive ancestors.



From "Early Man", courtesy Time-Life Books
Drawing Rudy Zallinger © 1965 Time Inc.

Ramapithecus, who is believed to be the earliest man-like primate. He is said to have branched off from the apes over 14 million years ago. He was first identified from a fragment of jawbone found in India in 1934.

Homo sapiens: 20 million years in the making

by William Howells

TODAY we can almost point to the first real "ancestor" of man. By this ancestor I mean a creature who, among the evolving primates of 20 million or more years ago, had just branched off from the group of our nearest relatives, the apes—a creature, still very much like an ape himself, whose descendants nevertheless evolved continuously in a different direction from that point on. We are quite sure we have the fossil jaws of such a creature—his name is *Ramapithecus* (named romantically for the Indian god Rama)—who lived about 14 million years ago, and the story of our knowledge of him is an interesting story about science itself.

We have realized for some time that man arose in this way, from animals leading to the apes on one side and to ourselves on the other. After Darwin's great book, "On the Origin of Species", had made inevitable the acceptance of evolution (including human evolution), Thomas Huxley almost at once showed how closely, in every way, we resemble the great apes. He said, in fact, that they, the apes, are closer to us than they are to monkeys.

This led to a lot of public jokes and private dismay, and the idea was resisted in many ways, by scientists as well as others. But now, after a hundred years, all the study of anatomy and, quite late, of such things as the molecular structure of proteins has only shown more and more positively that Huxley was right. Indeed we can go a step beyond Huxley and say that apes of Africa, the gorilla and chimpanzee, are more closely related to man than is any of the three to the orang-utang of Indonesia.

After Huxley's time, some anatomists pointed to the fact that apes are adapted in body form for brachiating, or hanging and swinging from their arms. This is a particularly good and safe way for a large animal to move in trees. Pointing also to our own broad shoulders and flat, broad chests, as well as to details of our elbow and wrist joints, and arrangements of muscles, they argued that our ancestors were likewise adapted to a considerable degree for brachiation, and for life in trees. This was one more argument for close relationship to the apes.

Here again, other anatomists resisted the idea, arguing that the resemblances were not very significant, and perhaps had evolved in parallel with the apes. They preferred to think of an ancestral line which had been separate from apes, or even monkeys, for a very long time. (Always in the background there seems to have been an unconscious revulsion against relating ourselves to chimpanzees, by people who looked on them as "animals", not noticing how large-brained and intelligent these same animals really are.)

They had arguments: we do indeed stand upright, and our feet are very different from an ape's; and our jaws are now quite different, particularly with small eye teeth which do not project above the other teeth in the obvious way an ape's do. Could these larger teeth have evolved backwards to smaller ones? Could the hand-like foot of an ape have been made over into a human foot?

These difficulties are not as great as they once seemed. Such changes are almost commonplace in animal evolution, with teeth being diminished or lost, and limbs modified in drastic ways. In addition, we must not try to picture our common ancestor as though he were a chimpanzee or gorilla; these animals have been evolving too. As study has gone on, and fact is piled on fact, most anthropologists have become convinced that our forebears did indeed use trees like the African apes, who actually live more on the forest floor than in trees.

Still later, fossil jaws of the ancestral ape *Dryopithecus* drew attention to the very close likeness of the molar teeth in ourselves and apes. Though the first specimen was found in France in 1856, it was during the early part of this century that such fragments were discovered in greater numbers, from fossil-bearing beds of Miocene and Pliocene age, and in the time range of about 20 million to 8 million years ago.

The fossils have come from other parts of Europe and from India, and later from East Africa, Georgia (U.S.S.R.) and China. With all this, the web of evidence has drawn tighter around our connexion with the apes. For *Dryopithecus* was evidently the ancestor of the large apes, and his remains are so widespread that we can now hardly expect to find a new and different fossil group in the future from which we ourselves might have come.

Another important fossil "ape", *Oreopithecus* of Italy and East Africa, who lived at the same time, became well known a few years ago. But,

CONTINUED NEXT PAGE

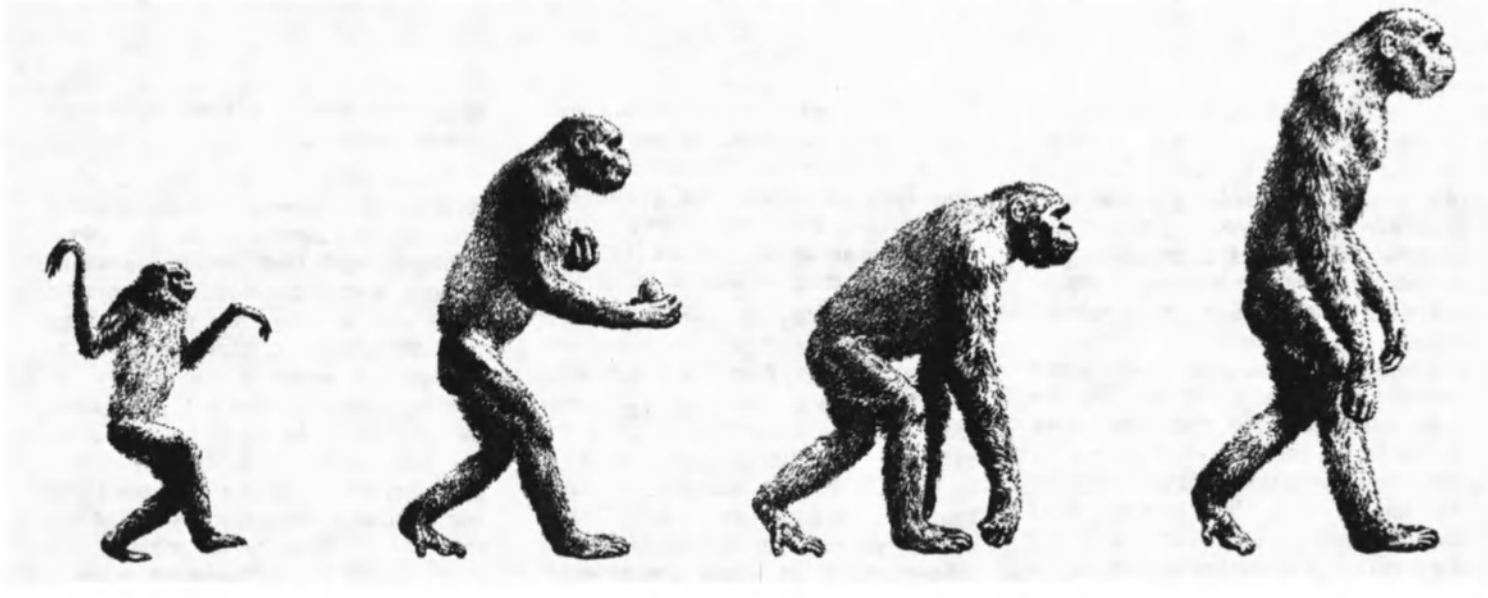
WILLIAM HOWELLS, *of the United States, is an International authority on prehistoric man. He is professor of anthropology at Harvard University and a past president of the American Anthropological Association. Associate editor of "Human Biology" and "American Naturalist", he is widely known for his books on the story of man's emergence, many of which have become best-sellers (see bibliography, page 71).*

TERTIARY PERIOD

37 MILLION YEARS | OLIGOCENE | 26 MILLION YEARS | MIOCENE

THE ROAD TO HOMO SAPIENS

Drawings on the next four pages show artist Rudy Zallinger's impression of primate and human evolution. The drawings are reproduced with the kind permission of Time-Life Books, New York, and are taken from "Early Man", a richly illustrated volume in the "Life" Nature Library series which young and old readers alike will enjoy (see bibliography, inside back cover). Above the figures is shown a time scale. The progression is not always strictly chronological since in certain cases considerable overlap existed. Proto-apes and apes were quadrupedal but are shown standing for comparison.



PLIOPITHECUS

An early proto-ape, it resembled the modern gibbon although its arms were not as disproportionately long. Now classed as an ancestor of the gibbon line. First fossil remains found in 1834.

PROCONSUL

Once regarded as a direct ancestor of man, but now considered as a very early ape, the ancestor of the chimpanzee and perhaps of the gorilla. Numerous fragments found in East Africa add up to almost complete skeletons. A contemporary of "Pliopithecus".

DRYOPITHECUS

First of the fossil great apes to be discovered, its remains have been unearthed throughout Europe and in North India and China. Fossils range from about 20 million to 8 million years in age. Man is considered to have emerged from "Dryopithecus" stock.

OREOPITHECUS

A contemporary of "Dryopithecus", it is believed to have stood about 4 ft. tall and weighed about 80 pounds. Its remains, discovered in Italy and Africa, led scientists to wonder if it could be a direct ancestor to man, but it is now widely regarded as a side branch of the ape family.

20 MILLION YEARS *(Continued)*

while his body form was rather like a chimpanzee's, showing a similar kind of adaptation to trees in a related animal, his teeth are quite different from a chimpanzee's and from ours as well, a fact which only links our descent still more closely to the apes of Africa.

It was out of the *Dryopithecus* stock that man emerged, and in fact it was from among the fossils of *Dryopithecus* fossils that our ancestor *Ramapithecus* became known. G.E. Lewis of Yale in 1934 described the first upper jaw, found in India's Siwalik Hills, and pointed to some man-like features.

Your own mouth will show you these things, where you can feel them with your finger. Your dental arch is short and rounded in front, while that of apes has become increasingly longer and broad across the front, with large canine teeth and broad incisors. Your molar teeth have the cusp and furrow pattern of *Dryopithecus*, but are square; an ape's are longer. This length makes an ape's face projecting; yours is straighter.

Approaches to the human shape could be seen in the small fragment of *Ramapithecus* as though he had just set his foot on a path diverging from *Dryopithecus*, although unfortunately we have not found the foot, only the jaw. So Lewis thought *Ramapithecus* might belong in our ancestry.

But the tide of scientific opinion—and such tides are apt to influence, not facts, but the way we see facts—was against *Ramapithecus*, and the fossil was put away in a drawer as simply one more kind of *Dryopithecus*.

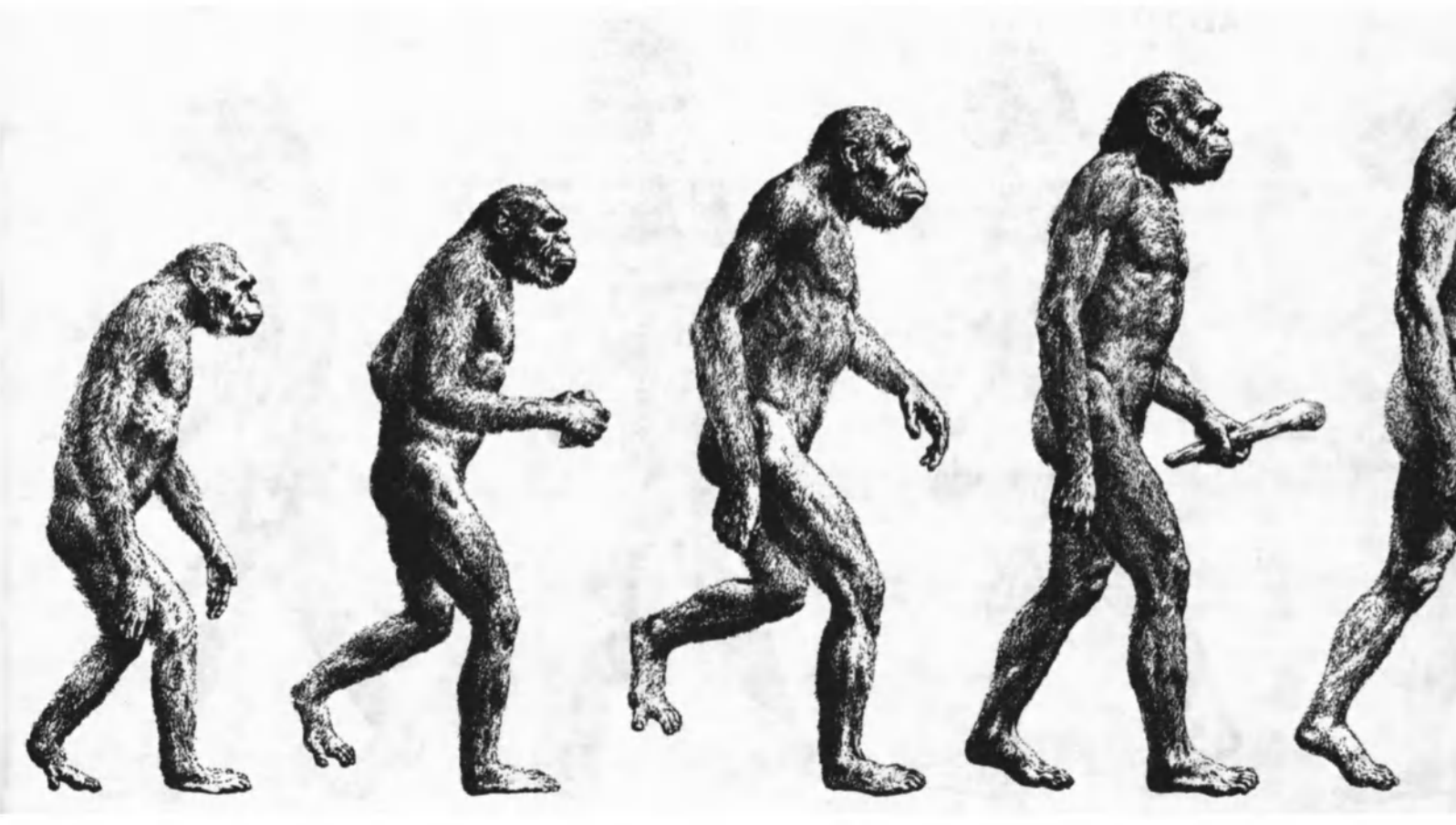
12 MILLION YEARS

PLIOCENE

3 MILLION YEARS

QUATERNARY PERIOD.....

PLEISTOCENE



Drawings Rudy Zallinger © 1965 Time Inc

RAMAPITHECUS

Now considered by many specialists to be the oldest of man's ancestors in a direct line. Probably still lived in trees and resembled ancestral apes more than man.

A. AFRICANUS

The first hominid, this early form of "Australopithecus", (or "Ape of the South") was a biped, walked upright and was able to run in the open plains. This major change from tree-hanging and using the arms when walking on the ground (like apes) happened some time before 5 million years ago.

A. ROBUSTUS

Though he stood upright and had hominid features, "A. Robustus" represents an evolutionary dead end in man's ancestry. Dr. Leakey maintains that none of the Australopithecines can now be considered in a direct line with the genus Homo (see p. 25).

ADVANCED AUSTRALOPITHECUS

Possessed a bigger brain than his predecessors, was a bipedal walker. A contemporary of "A. Robustus". Primitive tools discovered with both in East Africa but which creature produced them is not certain. Known as the Pebble Culture, the tools are small stones with only a few flakes.

After almost 30 years, however, L.S.B. Leakey found a very similar fossil at Fort Ternan in Kenya, which he could date as being 14 million years old.

It happened that at the same time, Elwyn Simons at Yale was looking once again at *Ramapithecus*. He was impressed with what Lewis had pointed to, and saw the same features in Leakey's new specimen.

Perhaps more important, Simons rescued other pieces of *Ramapithecus* from burial in museum drawers. He began examining old collections in various places from the U.S.A. to India, and recognized a few more fragments with the same special features, fragments which had previously been misnamed and ignored, but which he identified as fossils of *Ramapithecus*.

This careful sorting out made it easier to see the slight distinctions between *Ramapithecus* on one hand and *Dryopithecus*, ancestor of the apes, on the other. Thus we also see the beginnings of the separating paths of human and ape evolution, or between animals properly called pongids (apes) and those called hominids (anything on the human side of the same group). So palaeontology is not all looking for fossils in old river banks.

What brought the split about? Evolution has "reasons"—it follows lines of successful adaptation—but we know so little about *Ramapithecus* having only his jaws and teeth, that we cannot see the "reason". We cannot simply say that it is better or more successful to be "human",

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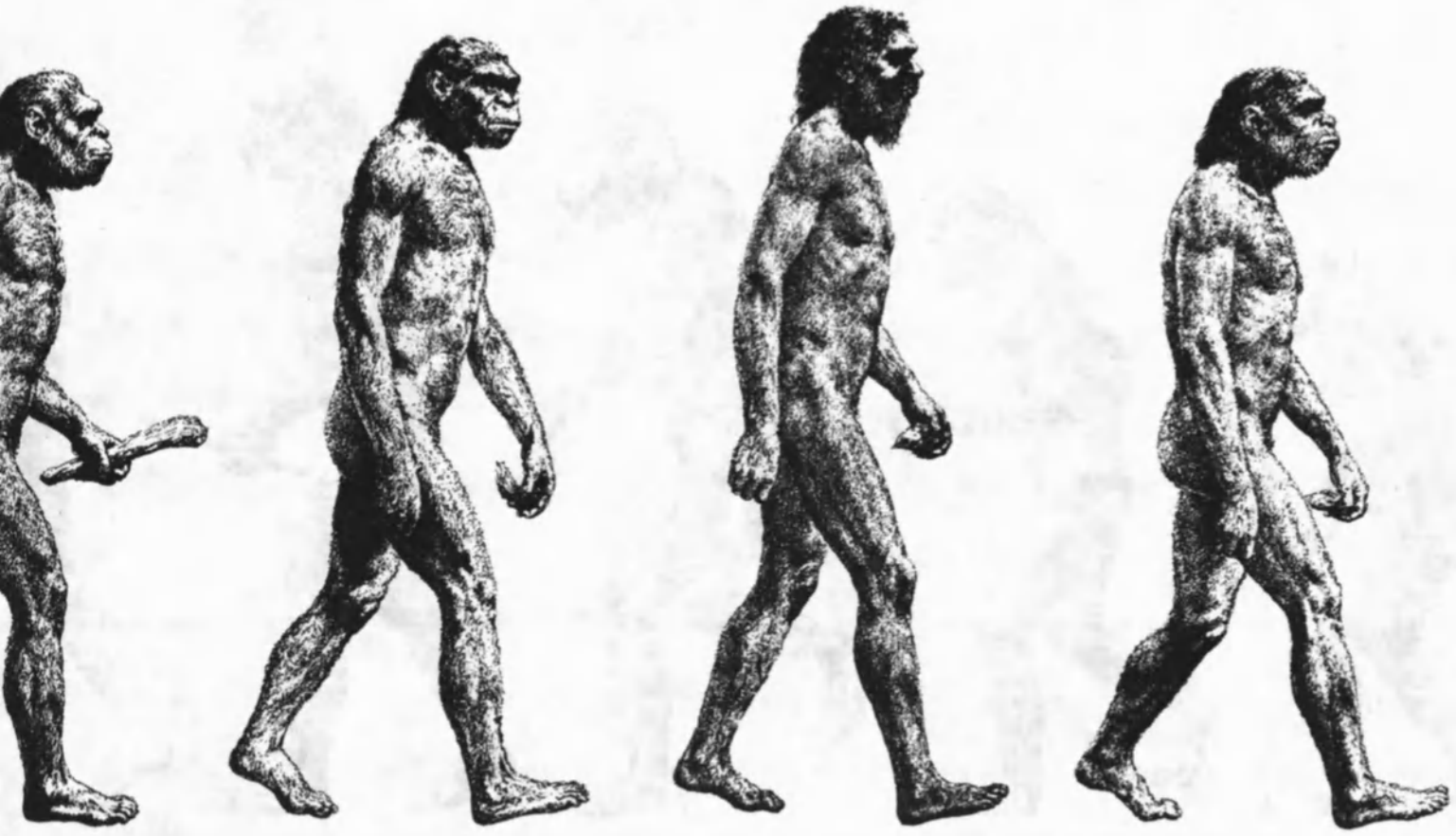
1 million years ago

250,000 years ago



HOMO ERECTUS

Usually referred to as the first "true man" of the genus Homo, but we now know that earlier australopiths had many similar traits and also worked tools. He knew the use of fire and produced the first true handaxe (Abbevillian culture). First "Homo erectus" found was the famous Java Man of 1891.

EARLY HOMO SAPIENS ?

Far more advanced than "H. erectus", includes Swanscombe and Steinheim Man of Europe (250,000 years ago), probably the earliest example of man's modern species. His cutting implements were standardized and finely made (Acheulean culture). Acquainted with simple geometrical forms.

SOLO MAN

Extinct race of "Homo sapiens" in Java. Known only from two shinbones and skull fragments. Lived at the same time as Neanderthal but his skull was more primitive, more massive and thicker with heavier brows, and closer to "Homo erectus".

20 MILLION YEARS *(Continued)*

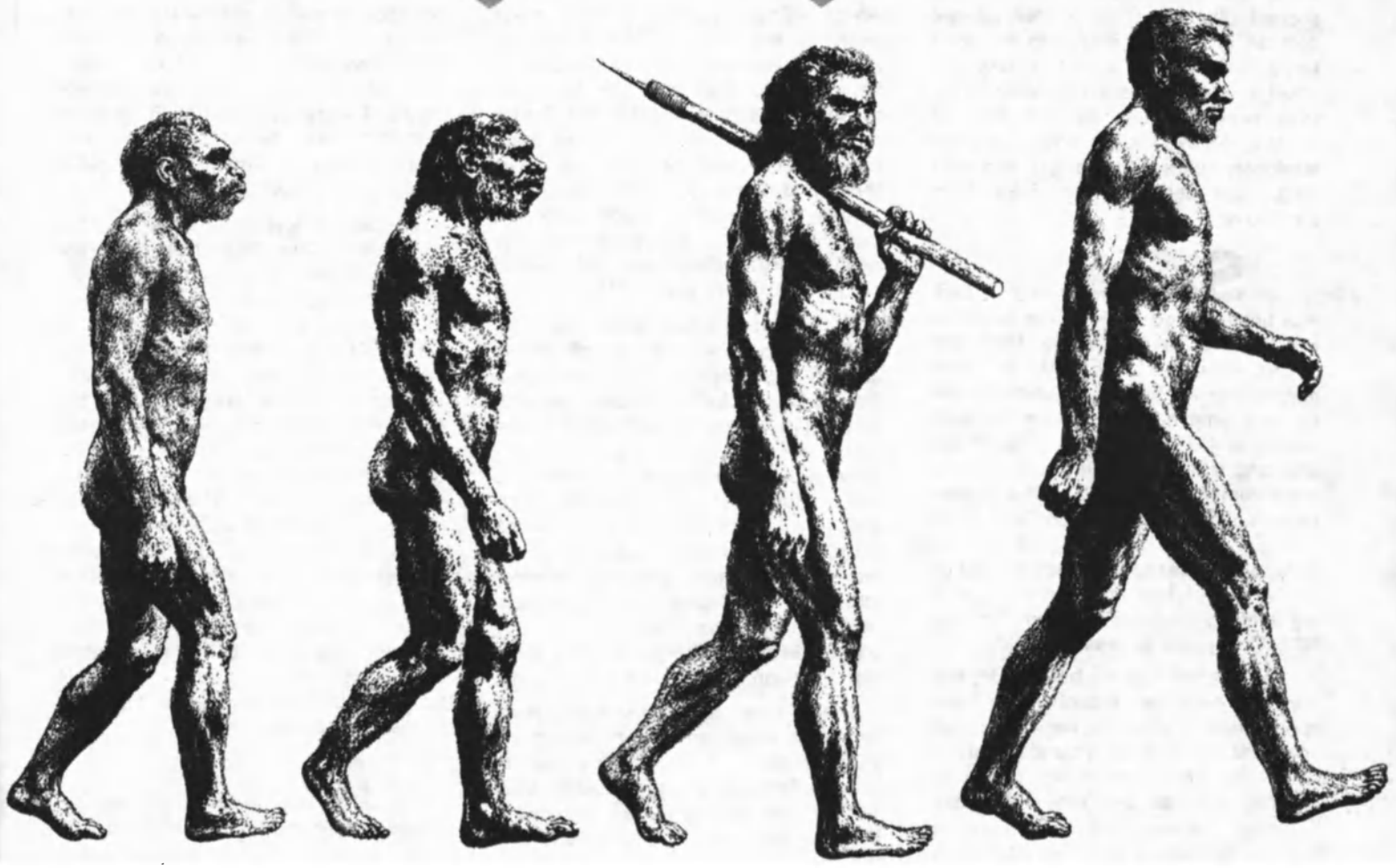
because that really means nothing, and *Ramapithecus* certainly resembled the ancestral apes far more than he resembled man. Like some chimpanzee populations he seems to have lived in an open wood and, again like chimpanzees, it is probable that he was still a tree-user.

Professors Simons and Keith Jolly, however, think he had begun to differ in diet from chimpanzees (who eat much coarse wild fruit) by using tough but nutritious foods like nuts, seeds and hard roots. This is because his teeth had thicker enamel than an ape's, and showed signs of heavy wear. He seems to have used his molars as grinders, more than his front teeth, and this would be related to his shorter face.

Ramapithecus lived from some time before 14 million years ago down at least as far as 8 million. Then, simply because no fossils have yet been found, there is a gap in knowledge until 5 million years ago. But surprising changes must have taken place: by this time much more obvious human ancestors had appeared, and they are fairly well known from the time between about 4 million and 1.5 million B.C. Here also, however, there was a long wait for recognition in the face of doubt.

It was in 1924 that Raymond Dart in South Africa saw the first skull, of a young child, in a box of fossils brought from Taung. He thought from its face and teeth that it stood halfway between man and ape, and he named it *Australopithecus* ("ape of the south"). But he had not found

150,000 years ago 40,000 years ago



Drawings Rudy Zallinger © 1965 Time Inc.

RHODESIAN MAN

Lived in southern Africa, perhaps at same time as Solo Man in Java. Certain authorities believe he may have been alive as recently as 30,000 years ago and actually have overlapped with modern man.

NEANDERTHAL MAN

Lived 150,000 to 35,000 years ago not only in Europe but also in Africa, Middle East and Far East. Made a variety of tools of advanced design. Classic European Neanderthal man is now excluded by many scientists from the direct "Homo sapiens" line.

CRO-MAGNON, UPPER CAVE AND BOSKOP MAN

Cro-Magnon lived in Europe, Boskop in Africa and Upper Cave Man in China. Although most research in the past was concentrated in Europe and concerned Cro-Magnon man, recent studies are beginning to throw more light on the African and Mongoloid ancestors.

MODERN MAN: HOMO SAPIENS SAPIENS

Two schools of thought today exist regarding modern man's recent ancestors: the monocentric believes that today's races had a common ancestor; the polycentric sees them descending from different ancestral lines.

—and we never do find—a complete skeleton, adult, and exactly dated; and his colleagues rejected his idea, believing this juvenile, still with its milk teeth, to be merely an interesting new ape. Much later, and slowly, did the many finds arrive which showed that Dart himself had been too cautious. (The further fossils were found years ago by Dart and Robert Broom in South Africa. New ones are found every year, greatly added to by discoveries in East Africa by Dr. and Mrs. Leakey (at Olduvai Gorge) and their son Richard (in northern Kenya) as well as by Professors Camille Arambourg and F. Clark Howell.)

In the jaws of these australopithecines, the large (but human) back teeth also strongly suggest powerful chewing for tough foods. The front teeth (canines and incisors) were small and entirely hominid in nature, not something partly ape-like. For several million years there were two lines of these australopiths: *Australopithecus*, barely the size of a modern African pygmy, and *Paranthropus*, who was a little larger but had jaws as powerful as a gorilla's, though the jaws were short and deep (for grinding with the back teeth), not long, with a gorilla's large canines (for stripping forest vegetable food).

The australopiths, we know, were bipeds like modern man, capable of running in the open plains. Their hip and leg bones differ from ours today in some ways, showing that they were less efficient walkers. Nevertheless, some time before 5 million years ago

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No knuckling under to run faster

they had passed a major milestone of change, from tree-hanging, and from using the arms when walking on the ground (like apes), to a free upright gait on an arched foot with an erect torso. Apes can walk this way but poorly: their feet are flat, their great toes protrude and do not help in pushing forward, their knees will not straighten (except in orangs), and their long, high pelvic bones make them top-heavy.

So we now know that definite hominids go back before 5 million B.C., while at the same time our strong likeness to the African apes means that we have a common ancestor at a time not too remote. *Ramapithecus* looks like the beginning of our line, and if he seems very ape-like we must remember that it is the human side, not the ape, which has been changing most rapidly. We can be sure our ancestors abandoned trees and a diet of fruit and coarse vegetable matter, perhaps only in the last 10 million years or less.

The reasons why we became bipeds are far from clear, though many have speculated. Even now we cannot run very fast: on uneven ground a gorilla, using the knuckles of his hands in running, can go as fast. We can, however, cover long distances in hunting, but could the first bipeds do so? Carrying food in the arms to a safe eating place might have encouraged uprightness: so might the need of a small animal to rise and peer over tall grass.

Perhaps, in our tree life, we became adapted to uprightness, as did apes, but not to such a degree that, as in apes, a heavy torso and long arms encouraged throwing part of our weight on our arms. Perhaps several such factors combined; we cannot say. But bipeds we were by about 5 million years ago, with important changes still going on in hip bones and feet to make this kind of gait more effective (see photos pages 42-43).

The australopiths are our undoubted ancestors at that time; there are no other possible candidates. Once again, there is controversy over the actual path of evolution. Some think there was only one varied species of australopith, not two distinct lines. And in former days it was assumed that there must have been a "cerebral rubicon", a magic brain size of about 750 cubic centimetres below which an ancestor could not be "human".

But simple stone tools, which are over two million years old, have now been found near Lake Rudolf in East Africa. They could have been made only by the australopiths since no more "advanced" men are known to have existed then; and the brains of these australopiths were not larger than a chimpanzee's. So shaped stone tools did not wait for "man" to make them, and it is thought likely that tools actually helped the australopiths to become "man", by accenting the evolutionary advantages of skilful hands and larger brains (1).

At any rate, this was the next major step, the advent of *Homo erectus*. His appearance, about 1 million B.C., probably follows another small gap in the record which might make the difference from *Australopithecus* more obvious. "*Homo*", a new genus, recognizes the difference, and the new group. Also *Homo erectus* is commonly spoken of as the first "true man", but it is not clear that such an expression is justified, since many of his traits were already present in the australopiths, who were also working tools at an earlier time.

These new men, however, must have presented an appearance more like our own. In body size, and in general features of the skeleton, they were much the same as ourselves. The head also would have looked more "human", with a smaller face and with jaws dominated at last by the braincase. However, this braincase was thick, and brain size had come only half the way from australopiths to modern man.

The first *Homo erectus* to be found was the famous Java man (originally named *Pithecanthropus)*, of 1891. He caused a scientific explosion, as the first really primitive man to come to light, and even his own discoverer came to think that he was really a large tree-living ape. He reigned virtually alone (very recently five new examples of his skull have been found) until the Peking men of north China were discovered, but *Homo erectus* is now recognized from East and North Africa, and in Hungary (Vertesszollos) and Germany (the Heidelberg jaw).

We know little about the transition to *Homo erectus*, or where it took place. Writers like to argue for either Africa or Asia as the "home of man", but this may not be important. *Ramapithecus* probably reached India from Africa 10 million years ago at least, and after that there must have been hominids in both continents, at the stage of *Australopithecus.* It happens that their remains so far have been found mostly in Africa, in favourable spots like Olduvai Gorge.

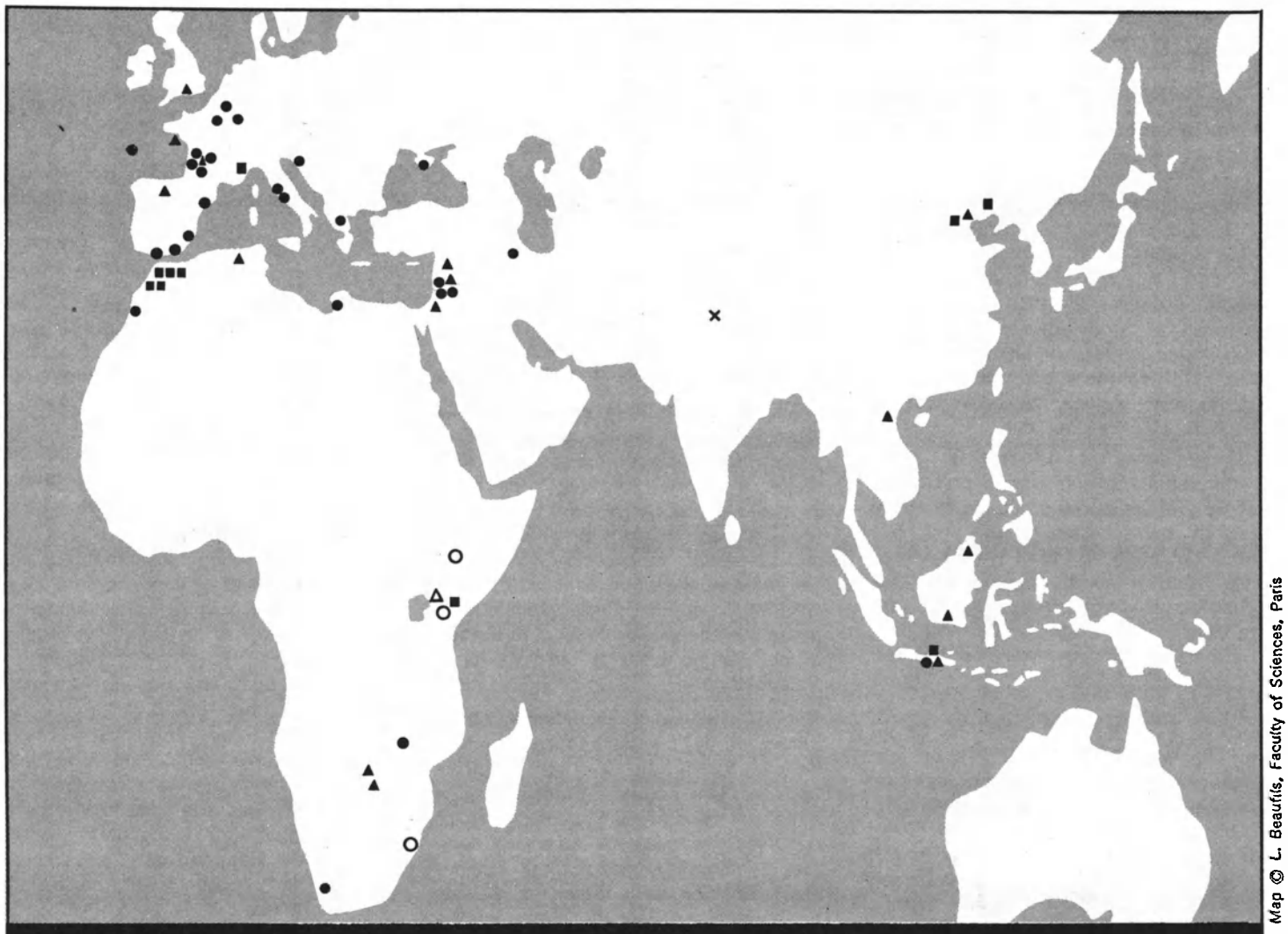
We have a few suggestions of what occurred. The large-jawed *Paranthropus* seems to have changed hardly at all during three million years or more. The site of Swartkrans, in South Africa, yielded many of his known fossil parts. It also provided two or three jaw fragments, of the same age, which Broom and Robinson twenty years ago believed to be different from *Paranthropus*, and more advanced in form. They christened the type "Telanthropus", though Robinson later decided that the parts belonged to *Homo erectus.* In either case, two different hominids were there together, one being *Paranthropus* and the other a more advanced kind. Here is a powerful argument for the real existence of two different forms at the same time.

A few years ago, by an almost magic piece of luck, three men were looking over these and other fragments in the collections in Pretoria when they noticed broken edges which could be fitted together to make larger pieces, where this had not been seen before.

They were able to join the "Telanthropus" upper jaw to much of a face, an ear region, and a bit of forehead. (Palaeontology, I said, is not just a matter of looking in river banks.) This gave most of the face and front of the skull, to which the lower jaw of "Telanthropus" would have been a fairly good fit. The whole thing suggests *Homo* even more strongly than before, but seems to be too small in size.

At about the same time Mrs. Leakey found a small crushed skull in the lowest levels of Olduvai Gorge, below the well-known *Zinjanthropus* (a *Paranthropus)* and dated to not quite two million years. This was only the latest in a series of similar finds from Olduvai, all of which had been called *Homo habilis* by Leakey and his associates. Though fragmentary, they were obviously not *Paranthropus*, having higher skulls and smaller jaws, and to many they suggested the

(1) *Some of these same australopiths, before the tools were found, had already been classed by Leakey and others as very early "men", or* Homo *and, following a suggestion of Professor Dart, were named* Homo habilis, *with the sense of being "good with the hands". We shall come back to this.*



Some of the principal sites at which fossil remains have been found. Map prepared under the supervision of Professor J. Piveteau, Director of the Laboratory of Human Palaeontology, Faculty of Sciences, Paris.

Map © L. Beaufils, Faculty of Sciences, Paris

smaller South African form *Australopithecus.*

After a great deal of work, the new skull was put together. This and the reconstructed "Telanthropus" give us a better picture: they are somewhat more advanced than the known *Australopithecus* but are still very small for *Homo.* They may well be showing us the ancestor who had just begun to make stone tools and who, in the next million years, turned into *Homo.*

Again, controversy. Some prefer to call this little person *Homo habilis,* in the belief that both *Australopithecus* and *Paranthropus* became extinct, and that this graceful little creature developed directly into high-skulled, large-brained *Homo sapiens* without passing through the stage of low-browed, thick-skulled *Homo erectus.*

But this raises the problem of who might have been the ancestor of *Homo habilis,* unless it was *Australopithecus,* whom he greatly resembles; and also the problem of why remains of only *Homo erectus* have been found for the period immediately after. It seems safer to assume, for the present, that the *Australopithecus* line began making simple tools nearly 2 1/2 million years ago and, during a time from which we have almost no fossils, grew larger in size and advanced to the *erectus* stage, while *Paranthropus* continued contentedly munching coarse vegetable food with his great jaws, ignoring tools, until he became extinct.

If the first *Homo erectus* to be found, the Java Man, was considered in the 1890s to be very subhuman, we know better now. In Africa, and evidently in Europe, he made large stone hand-axes, or coups de poing, increasingly well-shaped in comparison with the earlier pebble tools.

We do not really know about how he used them. All we can say is that he occupied the warmer parts of the Old World for at least half a million years (and even some cool places in Europe and China), as the major glacial periods were beginning; and that in this time he showed some evolutionary progress in brains which became larger and skulls and jaws which became less massive.

At the moment, he may now seem more like a well-defined "stage" than he should, because we not only lack fossils from the period just before, but also have very few from the hundreds of thousands of years following the second (Mindel) glaciation. Change doubtless went on by small steps during these times, but we cannot see the steps just now.

The Swanscombe and Steinheim skulls, of the Second Interglacial, perhaps 250,000 years ago, and the new Tautavel skull from the early Third Glacial, are important. They are much advanced over the known *erectus* men, but they are still too few to help us much, or show what was happening worldwide. It is only in the Third Interglacial and the last, or Fourth Glacial, mainly within the last 100,000 years, that we come again to a wealth of fossil men, and to the Neanderthal problem, the greatest controversy of all.

When the first of the Neanderthals

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Neanderthal man, father or distant cousin ?

was reported in 1856, he too was thought to be subhuman by some, but only an exceptional modern man, possibly a diseased person, by others (the first controversy, now forgotten). A Neanderthal skull is indeed exceptional, being very long and low, with a continuous protruding bony browridge across the forehead containing well-developed sinuses or air spaces. But the skull contours are not those of *Homo erectus*, and the brain was at least as large as our own.

Neanderthal man's face was equally remarkable; it was long, protruding sharply forward in the midline from the top of the nose on down. Had his nose not been so broad we might call him "hatchet-faced", but modern "hatchet-faced" north Europeans are apt to be tall and slender, while the Neanderthals of Europe were short and stocky.

CONTROVERSY over primitiveness and antiquity did not last long. Today we know that Neanderthal man occupied Europe in the Third Interglacial and much of the Fourth Glacial periods (perhaps between 150,000 and 35,000 B.C.), and that he was the author of the Mousterian varieties of retouched flake stone tool, which were technically far advanced over something like a handaxe. These tools in some ways foreshadowed those of the Upper Palaeolithic, which were made from bladelike flakes and were used by Cro-Magnon man among others.

For a hundred years now, discoveries of skeletons of the European Neanderthals have given rise to a conception of his "classic" form as I have described it. They have also reinforced the conclusion that he gave way, with seeming abruptness, about 35,000 B.C. to men who were entirely modern in physique, though robust, and who were in fact like living Europeans.

This is the heart of the modern controversy, with strong opinions on both sides. I have stated the distinctiveness of Neanderthal man too simply and sharply, in order to begin with a contrast. In North Africa there were other Neanderthal-like men, more modern, in some ways, lacking the typical facial projection of the Europeans. They too were followed by modern men of rugged build, apparently coming from the east about the same time (35,000 B.C.), or perhaps earlier.

The Near East is more puzzling. Men with Neanderthal faces, and with Neanderthal peculiarities of the skeleton, existed in the early Fourth Glacial, with Mousterian tools. But their skulls were not as "classic" as the Europeans, and some of them were remarkably tall, like the Amud man of Israel, found by Japanese excavators. (Here we must remember that modern men vary greatly—Scots and Eskimos might be compared to these Neanderthals in body size.)

The argument is over whether the Neanderthals, in Europe or elsewhere, were in fact replaced by invaders, with really new Upper Palaeolithic methods of tool-making, in a brief period (a few thousand years); or whether the Neanderthals simply evolved into modern man on the spot, while his stone-working, adopting new techniques, made the changes from what is termed Mousterian to what is termed Upper Palaeolithic.

It is a complex argument, and is based partly on assumptions (and, I believe, partly on tides of scientific opinion, like older arguments). In spite of all that is known, ways of convincing opponents have not been found. Some archaeologists emphasize transition in tool-making. Other archaeologists grant that there are important Mousterian survivals in the early Perigordian culture of the upper Palaeolithic of France. But they see a clear break with the coming of a second culture, the Aurignacian, which has different tool-making techniques and also a wealth of decorative objects previously lacking. This they view as something entirely new, an intrusion; and they cannot imagine a simple cultural evolution.

Similarly, some anthropologists cannot imagine biological evolution so swift as to produce a modern face and skull from that of Neanderthal Man in a few thousand years. Others are doubtful about the shortness of the period, and emphasize intergradation in shape between Neanderthal and modern man, especially in the east. They hold that evolution, not replacement, presents fewer difficulties. They note that if there was an invasion, the source of the "modern" Upper Palaeolithic men has not been found and that, if the European Neanderthals are rather special, the Near Eastern Neanderthals are more intermediate and "progressive".

These scholars would paint a rather simple picture of human history, probably too simple. They suggest that there was everywhere a "Neanderthal phase" of human evolution in the last glacial period, out of which all of us —Eskimos and Scots alike—emerged as modern man. This broad view assumes that there were Neanderthal men everywhere in the Old World, as there certainly were throughout Europe and apparently around its edges.

Carleton Coon, in a well known book, "The Origin of Races", has argued for another theory something like this one. Modern races appeared in different parts of the Old World, not from a single Neanderthal phase or Neanderthal population, but from different races of *Homo erectus* already present in these places.

There are difficulties here, but the theory does recognize something important which the other scholars neglect: that there were other kinds of Ice Age men, such as Solo Man of Java and Broken Hill Man ("Rhodesian Man") of southern Africa, who had some of the primitive traits of Neanderthal man but were really quite different. They are less well known: they are discoveries, or facts, which are still hard to interpret. Solo Man, though living at the same time as the Neanderthals, had a much thicker and cruder skull, more like *Homo erectus*.

There is a final chapter to all this. What *do* we know about modern man himself? Living races seem very different, some with very dark skin, some with blond hair, some with narrowed eye openings. But in form of skull (and this is what we can compare with early man) they are really much alike, with smaller faces and higher, narrower braincases. This is my own conclusion, after having worked with skulls from all parts of the globe. I believe, as do many colleagues, that all must have some common source. But where, and when?

HERE we are in a shadowland lighted by too few discoveries. Outside of Europe, where we observe the disappearance of Neanderthal Man, remains are especially scanty. Nevertheless, striking recent finds seem to mean that *Homo sapiens* of our own kind existed elsewhere, in Africa and Asia, in the same period as the Neanderthals of Europe.

They are different from those "progressive" Neanderthals I spoke of. Several skeletons from Jebel Qafzeh, in Israel, have no radiocarbon date but come from cave levels in which the tools and the soils indicate a time fairly early in the last glacial period, probably well before 40,000 years ago.

And the skulls are surprisingly modern —not completely so, but being quite different from Neanderthals. Only the large bony brows, and perhaps larger front teeth, in some of them, suggest Neanderthal Man, and others of the tribe had quite small teeth, and smaller, modern brows and faces as well, as far as is now known.

Two skulls found by Richard Leakey in Kenya, of modern form or close to it—and not Neanderthal—are surely older than 37,000 years. Some authorities think they may be very much older. For to the east a skull from the Niah Cave in Sarawak (Borneo) has been dated by two methods to about 40,000 BC, and it looks like a Melanesian or possibly an Australian.

MODERN men of the same general kind had made the difficult water crossings (difficult for early men) to Australia before 30,000 B.C., and many recent discoveries attest the presence of such people there and in New Guinea over the next ten thousand years. In the New World, recent finds prove the Indians were in South America about 20,000 years ago, much earlier than had been generally believed, so that men had come to the Americas from Asia probably several thousand years before. No American skeletons are as old as this, but we can only suppose that these earlier men were like the later.

Now here is the important thing. All the known skeletons I have mentioned were of modern form. In addition, the European Upper Palaeolithic people had the nature of later Europeans; the early Australians were recognizably like later Australians or Melanesians; and we can only suppose that the first Indians of America were the same kind of proto-Mongoloid we see in them today.

The Omo skulls of Africa cannot be recognized yet, and otherwise there are no African skulls quite so old. But the signs are that, by the time the Neanderthals vanished, or before, not only was modern man fairly widespread, but the races we see today had already taken shape.

We still cannot say how this happened. It is strange that we should know so little of our nearest ancestors. But we cannot expect to have the whole story after only one century of searching. There are blank parts of our history now, but they will be filled: we have hundreds of years of exploration ahead of us. ■

Photo C. Loring Brace © "Natural History" New York

Big front teeth of Neanderthal man. Though now excluded by many from modern man's direct ancestry, Neanderthal man was much less of a brute than was first believed.

The life and times of Stone Age man

by François Bordes

DISCOVERIES in Africa indicate that the Old Stone Age, or Palaeolithic period, began more than two million years ago. The first stone-worker was *Australopithecus*, halfway between the great apes (gorillas, chimpanzees, orang-utangs) and ourselves, with a still rudimentary brain. His tools were simply pebbles, chipped to give them a cutting edge, and roughly trimmed flakes.

The evolution of man and his industries took place over a very long period. *Pithecanthropus* knew how to use fire, at least in China, and produced the Abbevillian and early Acheulean industries, traces of which are found in various parts of the world. Little is known of the various types of man in the Middle and Upper Acheulean periods; and finally, about 100,000 years ago, *Homo sapiens* emerged.

A distinction used to be made between Neanderthal man, *Homo neandertalensis*, associated with the Mousterian culture, and modern man *Homo sapiens*, of the Upper Palaeolithic age. The trend today is to establish two sub-species, *Homo sapiens neandertalensis* and *Homo sapiens sapiens*.

The exact relationship between these two fairly different types is still a matter of controversy. It is possible that there were intervening links, modern in some respects and Neanderthaler in others and the evolution of modern man must have taken place more or less simultaneously throughout the ancient world. Men of a present-day type existed as far back as the Mousterian period (as shown by excavations at Djebel Qafzeh in Israel and perhaps even before).

For the last 100,000 years, men have lived in very different environments, the result of geography or climatic variations. Such variations were particularly marked in the Quaternary or last of the geological eras: several times huge glaciers spread over not only Greenland and the Antarctic (where one can see their vast traces today) but also Scandinavia, North America and all high mountains, even at the equator. At their maximum, the Scandinavian glaciers covered the north of Germany, most of England, and a great part of the western U.S.S.R., while in France the Alpine glaciers came down almost to Lyons.

These Ice Ages were matched by oscillations when the earth's temperature fell, though the maximum cold did not necessarily coincide with the maximum glaciation. Depending on the period and the place, the cold would be damp or dry, and in the regions to the south of the glaciers a variety of vegetation developed, ranging from tundra to forest.

In Europe, however, the prevailing feature was more or less densely wooded steppes. This lowering of temperature naturally extended beyond today's temperate zones, but tropical and equatorial regions seem to have been little affected, though depending on the amount of rainfall there were periods when deserts spread or shrank almost to nothing.

The accumulation of water locked up in the huge glaciers (islandsis) meant that the level of the seas went down considerably, sometimes more than 300 feet, with inevitable geographical changes. England was a part of the continent, and Japan was attached to Asia. Our ancestors thus lived in a changing world (even if the changes were only gradual) frequently very different from the world we know.

Throughout this period tool-making depended primarily on stone as the basic tool for shaping other tools from wood, bone, antler, horn, leather, etc. These have all disappeared, with the exception of those in bone and antler, which have often been preserved.

Those who know nothing of the subject often speak slightingly of

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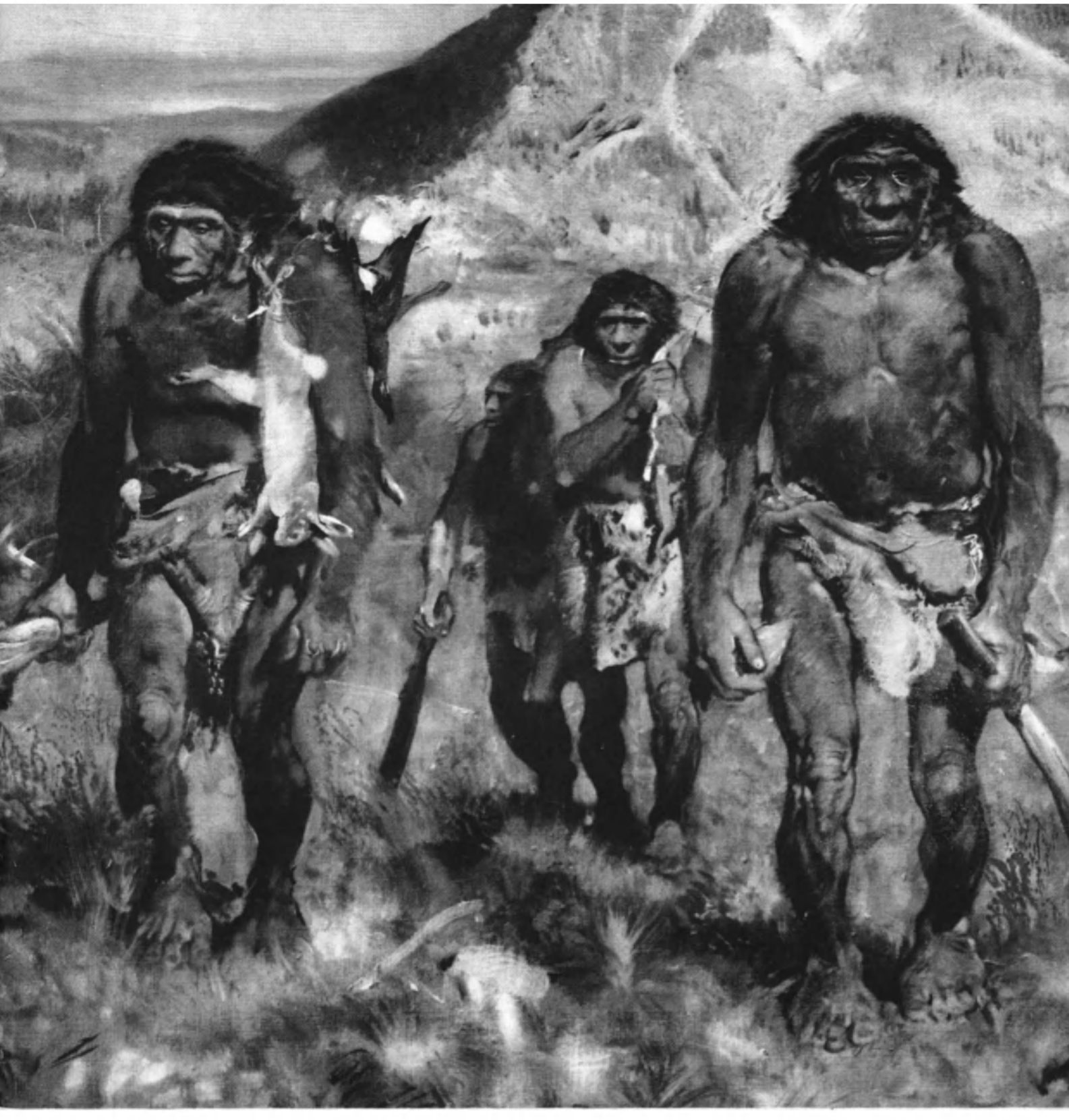
FRANÇOIS BORDES *is professor of Prehistory and director of the laboratory of Quaternary Geology and Prehistory at the University of Bordeaux and director of Prehistoric Antiquities for the Aquitaine region of France. An internationally famous authority on Palaeolithic tools, he can himself make all the known varieties of Palaeolithic implements (see photo story page 22 and bibliography inside back cover).*

A roving band of Neanderthalers, who lived about 100,000 years ago and vanished about 35,000 B.C. This painting by the Czech artist Zdenek Burian appears in "Prehistoric Men", published in Prague, Czechoslovakia, which is made up in major part of paintings by Mr. Burian with an introductory text by J. Agusta.

Painting by Zdenek Burian © Artia, Prague



The myth of the troglodyte 'cave men'

Palaeolithic man and his "clumsy flint tools". In fact, he was a consummate craftsman who made the best of his material. If many of his implements appear crude, it is because flint, though easily flaked by a skilful workman, has a fragile cutting edge which wears away quickly, or rather which chips; flint is harder than steel, as you will see if you scratch the blade of a knife with a piece of flint. Other tools or weapons, designed for lasting use or requiring a perfect form for functional reasons, were admirably well shaped.

Not all tools were of flint. In some regions flint does not exist and was replaced by obsidian (volcanic glass) which has a still sharper, though more fragile cutting edge, quartzite, sandstone and quartz, which is more intractable, but for which the right working techniques had been evolved.

In other areas, fine-grained eruptive rocks were used, such as basalt and rhyolite. Tools were often a varied collection, the finer ones in flint or volcanic glass, the rougher ones in basalt, quartz or quartzite; the choice of material depended on the use to which the tool was to be put.

For flaking stone, man first used another pebble; later, from the Middle Acheulean period onwards, he realized that better results could be obtained with a softer striking tool, or hammer, of a cylindrical shape, in wood, bone or antler. Perhaps during the Mousterian age, but certainly in the Upper Palaeolithic, he began striking by indirect impact, placing a wooden or bone chisel between the hammer and the implement to be shaped. He also used pressure flaking, which permits finer and more regular retouches, though smaller than those produced by striking. In the Solutrean period, about 19,000 years B.C., man discovered that strong heat applied slowly to flint, followed by a slow cooling process, changed the structure of the stone and made it easier to flake by pressure.

In the Upper Palaeolithic age men hollowed out limestone to make blubber lamps, sometimes decorated, but they did not, to our knowledge, fashion vases, which did not appear until considerably later. A distinction is frequently drawn between the Palaeolithic (The Old, or chipped Stone Age) and the Neolithic (the New, or polished Stone Age). But, apart from the fact that Neolithic man chipped stone far more than he polished it, artifacts in polished stone are by no means unknown in Palaeolithic times (for example in Central Europe); and partly polished axes have even been found in northern Australia, pre-dating those of European Neolithic by some 15,000 years.

Since the great bulk of artifacts in perishable material have not come down to us, our ideas about the daily life of our far-off ancestors are based mainly on the examination of bone and stone implements, the study of deposits, and a comparison with primitive peoples of today or recent times. In cold regions, our ancestors lived mainly by hunting, eked out by fishing, and, if the climate was suitable, the gathering of berries, seeds and roots. In warmer climates it is possible that fruit-gathering was a major food resource as it is today for the bushmen of the Kalahari Desert.

Living patterns were not the same for the Middle Palaeolithic (the Mousterian and similar industries), dominated by Neanderthal man, and the Upper Palaeolithic, by which time modern man has emerged. There are however a certain number of constant factors.

As regards living quarters, people often talk about "cave men" as if primitive men led a purely troglodyte existence. In fact, they lived chiefly

BIG GAME HUNTERS OF THE PAST

A group of Neanderthal hunters (right) drive Ibex over a cliff to be despatched by other hunters waiting below. The more advanced Upper Palaeolithic men, who superseded the Neanderthals, dug camouflaged pits near watering-places to trap mammoth and rhinoceros (opposite page).

Paintings by Zdenek Burian © Artia, Prague 1960

at the entrance to caves, or under overhanging sandstone, limestone or basalt rocks hollowed out by erosion. But these would have provided very poor shelter from the intense cold of the Ice Ages if they had not been suitably fitted up with skin tents or huts. Occasionally one finds traces of the uprights which supported the roof, or circles or rectangles of stones which indicate the foundations.

In or near these huts are to be found hearths, sometimes merely places for lighting a fire, marked by reddened stones and ashes. Elsewhere, there are more elaborate hearths—small circles of stones, or hearths floored with pebbles which were perhaps used for cooking; the fire heated the pebbles, which were then swept clear of embers and ash, and the meat was roasted directly on the floor.

Other hearths are full of stones which have been split by the heat. One can visualise two ways in which they were used. Either the stones, placed directly in the fire, accumulated heat and then radiated it when the fire was extinguished, or alternatively, when hot they were taken out with wooden tongs and thrown into a leather bag containing water, to make the water boil and produce a meat stock. The Eskimos use this technique today.

In warm regions, caves and shelters were probably fitted out more simply, with wind screens instead of huts. Open air camps probably resembled those of the bushmen or Australian aborigines, with screens or huts made from branches. In rainy areas, protection was provided by a roof of leaves or thatch.

Open-air camps are however also found in cold regions, either in areas where there are no caves, or else used as transient camps for the summer. Many of these camps are in Central Europe and the U.S.S.R. They range from the simple round family hut partly hollowed out of the earth, the walls reinforced with the bones of large animals, to the large community dwellings in the Don area, possibly corresponding to the "long

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Photo © Silvester-Rapho, Paris

PREHISTORIC INDUSTRIAL DESIGN

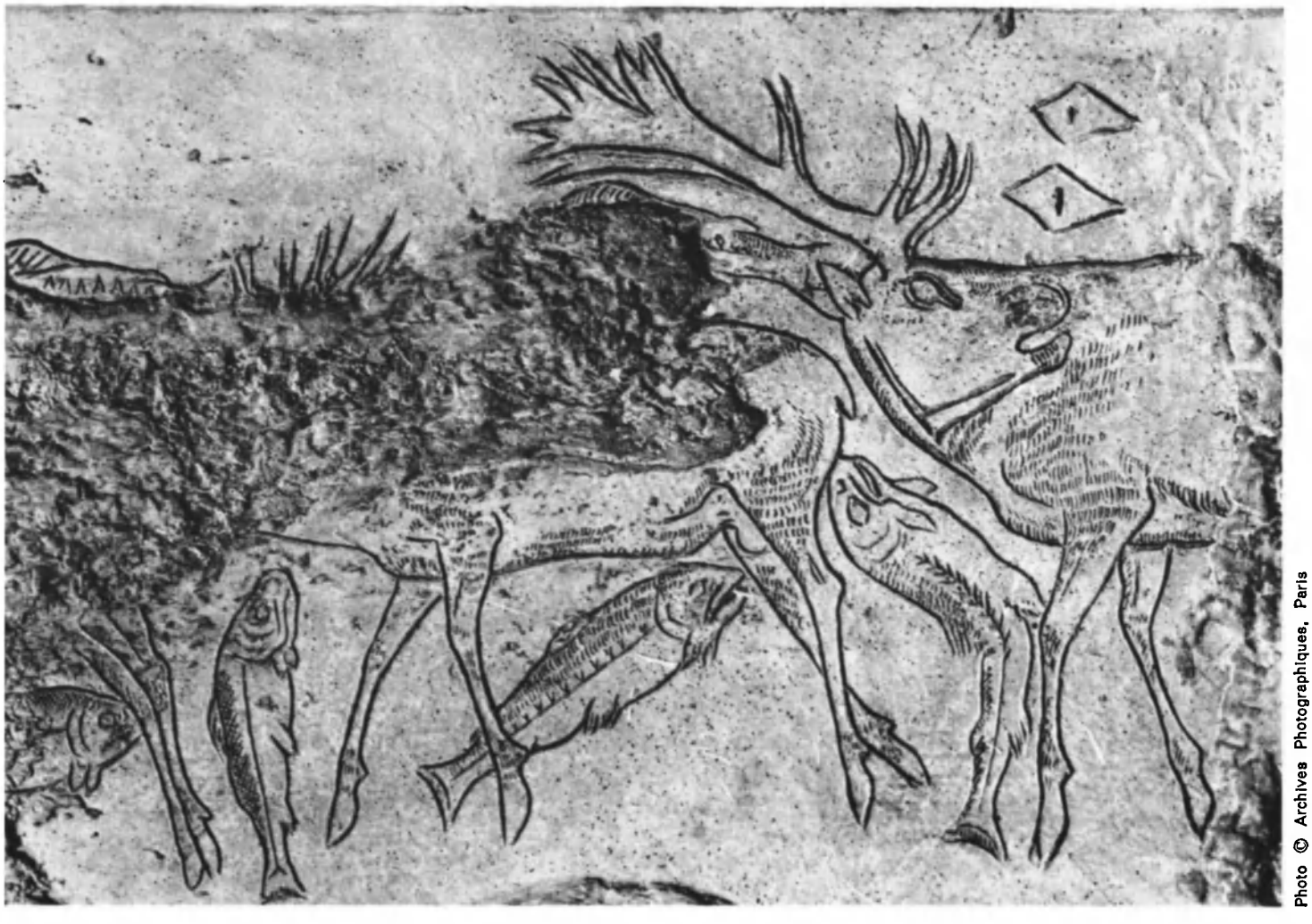


Photo © Archives Photographiques, Paris

Painting Zdenek Burian © Artia, Pragua

Photo Boyer © Roger Viollet, Paris

The woolly rhinoceros was a dangerous quarry to tackle at close quarters. To pierce his thick hide from a safe distance, early man developed spear throwers which gave added penetrating power to his spear. Photos right and top left show fragments of late Magdalenian (10,000 B.C.) spear throwers made from reindeer antlers and carved to represent a bison licking its flank and two ibex in an attitude of play or combat. Early man was a fisherman as well as a hunter. Top right, barbed Magdalenian harpoons and, left, decorative carving of reindeer and salmon, two important items in early man's diet.

Photo © Musée de l'Homme, Paris

Tools and artifacts for every occasion

houses" of the Red Indians in the eastern United States.

Such open-air camps also existed in France in Mousterian and Upper Palaeolithic times. In general, the only indications of the Mousterian camps are sites thickly scattered with chipped flints, debris, burnt stones and remains of bones. Upper Palaeolithic camps are well organized; frequently marked by a series of post holes to show where huts or tents stood, and positioned on small spurs overlooking two valleys, where possible on flat sandy soil. The reason will be clear to anyone who has ever camped.

WHILE the large dwellings in eastern Europe were probably permanent living quarters, the equivalent of the non-existent cave, the simpler ones in the west were most likely hunting or summer camps. From the fact that the tool kits found there are not basically different from cave tools of the same period, it can be deduced that the hunting expeditions included women, who were responsible for dressing skins and smoking meat.

It is possible that Palaeolithic man led a semi-sedentary life in the sense that the caves were inhabited all the year round by part of the group, and a semi-nomadic life in the sense that hunting expeditions were divided up into temporary camps. The same is true for bushmen today: sometimes the tribe lives all together, at others it breaks up into little groups.

As regards clothing, comic strips or illustrated novels often show prehistoric man with only the skin of an animal round his loins. This may have been the case during warm periods or on fine summer days, and of course in tropical areas where clothing was perhaps even more reduced. But for life in an ice age, particularly in winter, a costume similar to that of the Eskimos is much more likely, considering that the temperature must often have been below minus 40 degrees.

The bone needle was only invented in the Upper Solutrean age—around 17,000 or 16,000 B.C.—but while it is a help to sewing it is not indispensable. Earlier tool kits include bone points and flint drills with which it is easy to make holes in a hide. Thread was provided by vegetable fibres or the tendons of animals, in the same way as tendons of reindeer are used today by Arctic peoples.

There is also no doubt that Stone Age man had shoes, probably like moccasins, even though the footprints found in caves are all of naked feet.

Tool kits varied from one period to another and from one industry to another, probably corresponding to different populations. They also developed over the ages inside the same industry.

In the Mousterian age, stone tool kits are the overwhelming majority of the artifacts preserved, and are mainly of flint flakes. They include a variety of scraping tools—flakes with one or more edges trimmed to make them even. They may have been used for scraping hides, and certainly as knives and for woodworking. In addition, there are notched pieces, flakes with toothed edges like saws, scrapers, burins or gravers, borers, backed knives made from elongated flakes or blades with one edge broken off to make it possible to lay a finger along it (as with the blade of a modern knife).

Among some varieties of Mousterian tools, there are still hand axes or "coups-de-poing", multiple purpose tools, as in the preceding Acheulean age. Bone tools are no more than splinters with the end worn down (perhaps for making clothing) or bones which show signs of having been crushed, which may have been pressure tools for trimming flint.

IN the Upper Palaeolithic age tool kits were more varied and specialized. A small number of side scrapers subsisted, to be replaced by various kinds of end scrapers. The number and variety of gravers increased considerably, probably partly due to bone working, which became very important. Borers, backed blades and bladelets also play a role, but their purpose is not always clear. Bone tools included points, smoothing tools for sleeking hides, and towards the end, needles.

Weapons were used primarily for hunting, since war, in the modern sense of the term, was little known in Palaeolithic times, though there may have been brief skirmishes over territorial hunting rights. Weapons also varied from one period and one place to another. The Mousterians had flint points, spear or javelin heads, wooden spears, a few bone points and probably clubs. Upper Palaeolithic weapons were more developed—various kinds of flint projectile points, such as the magnificent Solutrean "laurel leaf" and shouldered points; also a great quantity and variety of bone points, and harpoons during the last, or Magdalenian period.

While Mousterian projectiles were thrown by hand, the Upper Palaeolithic age saw the development of the spear thrower, which is still used by Eskimos and Australian aborigines to give greater range and penetration to spears. It is just possible that by the Upper Magdalenian age bows were used, but so far there is no positive proof of this.

Hunting is as old as man, and it is highly probable that it was a factor in his evolution, setting a premium not only on strength and speed but also on intelligence. By the time of *Homo sapiens*, whether Neanderthal man or modern man, it had existed for more than two million years; and Acheulean man, more than 100,000 years ago and perhaps even 500,000 years ago, was already a big game-hunter or "giant-killer".

There were various means of hunting, with spears thrown by hand and later with spear throwers or bows, different types of snares, the use of fire to make animals stampede and leap off a cliff, tracking with several hunters taking over from each other until the prey was exhausted. This is probably how reindeer, bison and horses were hunted.

Snares probably varied with the size of the game: large herbivorous animals were probably caught in pits dug in the ground and covered with branches and leaves. Suspended traps were laid for carnivores, devised so that when the animal tried to take the bait he would bring down a roof weighted with heavy stones, or be pinned to the ground by a spear; snares with springs were probably used for smaller animals such as hares.

Fishing varied in importance according to the period; fish-bones are only rarely to be found in Mousterian deposits, though this may be due to the fact that little effort has been made to look for them. The Mousterians probably fished chiefly with spears or by hand, as we know of no special fishing equipment.

In Upper Palaeolithic sites, however, vertebrae and other fish bones are found fairly frequently. There are

small bone artifacts, pointed at both ends, which may have been straight hooks of the kind primitive tribes use today, harpoons (for both fishing and hunting), forked objects which may have been pronged harpoons, all chiefly in the Magdalenian age, during which fishing probably played an important part.

It is also probable that nets were already in existence. Some pebble-flagged floors are supposed to have been surfaces for drying fish. The catch seems to have been chiefly salmon and trout, but remains of eels, perch and pike are also found.

Little is known of plant resources, but fossil pollen analysis shows that the hazel tree must have flourished in Europe at some periods. Some acorns are edible. Wild strawberries, raspberries, sloes, blueberries and blackberries also existed and it is very probable that water-caltrops were gathered. The bulbs or tubers of several plants of the period, particularly the lily family, were edible, as also were wild carrots and sorrel. Gathering was part of the work done by women and children. In Africa and south-east Asia plant resources must have been even more varied.

THE use of fire has been known to man since *Homo erectus*, at least in Asia and Europe, for in Africa the indications are so far of a later date. This does not mean however that *Homo erectus* knew how to light it. He may simply have kept it alight after taking it from a fire due to natural causes such as bush fires produced by lightning, marsh fires, etc. But in the Mousterian culture and still more in the Upper Palaeolithic age, there is no doubt that man knew how to light fire.

There are two main methods, by rubbing and by striking. A pointed wooden stick may be rubbed to and fro in a groove hollowed out in soft wood, or rapidly rotated by hand or with a bow. Striking is not, as is often thought, the striking of one flint against another, as the resulting sparks are simply cold light; a flint is struck against a lump of iron pyrites. In some deposits fragments of iron pyrites have been found which show traces of having been struck; sometimes they are so worn that they must have been used regularly as lighters.

It is difficult to estimate the density of the population, which must have been thinly scattered, with occasional large concentrations of several hundred people living in neighbouring sites.

The expectation of life was not long, though recent research tends to lengthen the estimates. It was probably rare to live beyond fifty. There must have been a high rate of infant mortality and deaths in childbirth.

The first undeniable burials appear with the Mousterian culture. In Corrèze, at La Chapelle-aux-Saints, a man was found lying in a trench with his knees drawn up and his head protected by large animal bones. A bison leg had been placed by his head, and beside him in a small pit were a bison horn and frontal bone, as provision for a journey or a funeral offering. In a Mousterian deposit at Shanidar in Iraq, pollen analysis indicates that a man was buried on a bed of flowers.

In the Upper Palaeolithic age funeral rites were more complex. The dead were often buried with fine objects in flint and bone and elaborate necklaces of pierced shells, and were powdered with red ochre. Sometimes large stones were placed on their hands and feet, perhaps to prevent them coming back to haunt the living.

There are many children's burial places, and the Soviet prehistorian Okladnikov attributes this to the fact that Palaeolithic man was more interested in the fate of dead children than that of dead adults. It is also worth noting the large number of women's burial places, often as richly ornamented as those of men, which seems to indicate that discrimination between the sexes was unknown among Palaeolithic hunters.

Art probably appeared earlier than one imagines. Many Mousterian sites yield mineral paint such as black manganese dioxide and yellow and red ochre. But we know of no engravings, sculptures or paintings depicting animals before the Upper Palaeolithic age. The Mousterians probably used mineral pigments for painting on perishable materials, and perhaps their own skins, like Australian aborigines.

In the Upper Palaeolithic age, however, art developed considerably, particularly in the Magdalenian culture, producing splendid achievements in engraving, sculpture and painting comparable to those of classical antiquity. It is mainly animals that are portrayed, but in some caves such as those at La Marche (Vienne, France) we have a large number of human figures, frequently caricatures, as if the exact portrayal of the human figure had been taboo.

As regards magic and religion, various interpretations have been given to prehistoric art. When it was first discovered, it was argued that such art was an expression of a highly developed aesthetic sense; subsequently the theory was long entertained that prehistoric art was used to cast spells, either for successful hunting or to replenish the stock of game.

Recently, Professor Leroi-Gourhan's school has interpreted it as the expression of the dualism between male and female, some animals representing the male principle, others the female. There is certainly no straightforward answer; an explanation which may be valid for the Aurignacian period (30,000 BC) is not necessarily so for the Magdalenian (15,000 to 9,000 BC).

FOR a long time it was believed that paintings were to be found only on the walls of deep caves which may have been sanctuaries, but it now appears that most rock dwellings were decorated. The great bulk of decorated caves are in western Europe, but one has been found in the Urals.

Much has been conjectured about the religion of the Stone Age, but nothing is known for certain. Funeral rites seem to indicate a belief in another world. The theory of bear-worship by the Mousterians has been strongly contested, but recent investigations give it a new lease of life.

As regards social organization, we know very little, since in most cases we cannot tell the size of human groups during this period. We still do not know whether a given number of tools found in a particular layer represents 10 men over 100 years, or 100 men over 10 years, though recent studies are beginning to throw a little light. Similarities between tool kits and works of art suggest contacts between various human groups over fairly large distances.

In conclusion, much remains to be learned about daily life in the Stone Age, but what we do know suggests that while it was certainly a hard life, it was not on the whole a wretched one. Where game was plentiful, man must have had spare time for sculpture or story-telling. Unfortunately, while certain works of art have come down to us through the ages, the entire oral tradition of stories, legends and songs has disappeared for ever. ■

Stone age toolmaker 1972

Drawing © Pierre Laurent

Intrigued since boyhood with stone age flints, Professor François Bordes of the University of Bordeaux mastered the tool-making techniques of our ancestors and is now considered the world's leading authority on palaeolithic tools. He can produce any palaeolithic implement within a few minutes. Above, with a few judicious blows with a small stone used as a hammer, Prof. Bordes produces a rough but serviceable cutting edge on a lump of quartzite. Such rough and ready tools have been found in Africa, Asia and the Middle East and were early man's basic implement and weapon for over a million years. Below, Prof. Bordes demonstrates how, using only an antler hammer, a stone age hunter could transform a flake of flint into a laurel leaf point for use as a dagger or spear head. Left, an artist's impression of a Magdalenian toolmaker at work outside his tent.

Photos Marc Riboud © Magnum, Paris

Photo © Celebonovic, Geneva

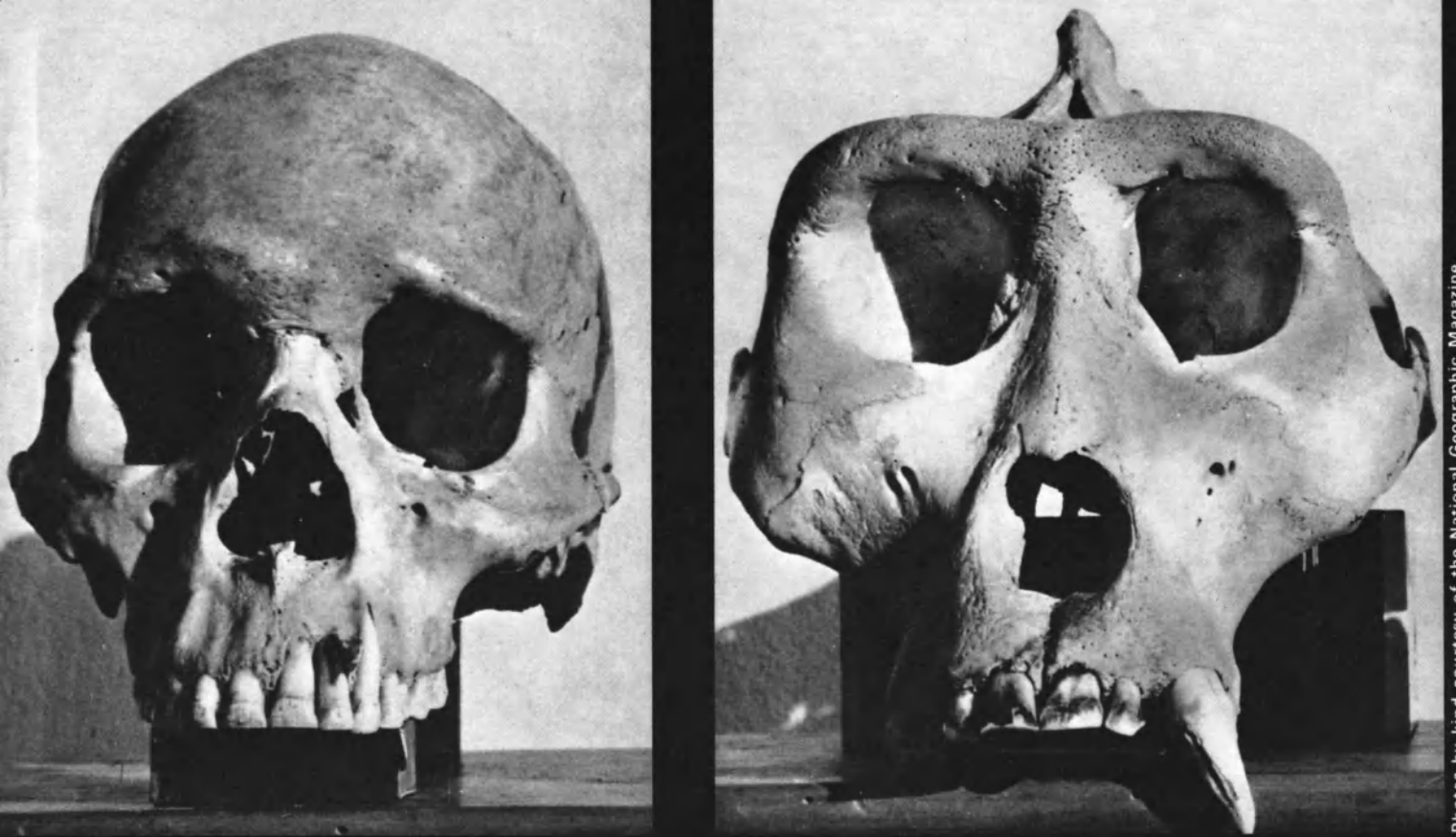
Beside this prehistoric oil lamp lie a pendant (with hole) two flint burins or graving tools, a scraper and (bottom left of photo) a harpoon, all products of the Magdalenian culture (15,000 to 9,000 B.C.).

Our African ancestors

by Louis S. B. Leakey

THERE have been so many discoveries concerning the evidence of man's origin during the past few years that nearly every textbook available today on this subject is out of date. The facts that will be given briefly in this paper have all been published in such scientific journals as *Nature*, or have been presented before international meetings and discussed by our colleagues. Only a limited part of the evidence is yet available in book form.

LOUIS S.B. LEAKEY, *of Great Britain, is world famous for his discoveries of fossil remains in East Africa. He began his first archaeological research there in 1926, when he was 23, and has devoted his life to this work ever since. His most exciting finds have been made in Olduvai Gorge, Tanzania. He is now honorary director of the National Museum Centre for Prehistory and Palaeontology in Nairobi (Kenya) and honorary professor of anatomy at the University College of Nairobi. He has published many books and studies on his excavation and research into man's past in Africa (see bibliography inside back cover). Dr Leakey took part in Unesco's 1969 international symposium on the origins of* Homo sapiens, *in Paris.*



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Left, the famous fossil skull of *Zinjanthropus* found by Dr. and Mrs Leakey at Olduvai Gorge, Tanzania, in 1959, and described at the time as the earliest ancestor of man ever found, dating back 1,750,000 years. The skull of this australopithecine is here compared with the skull of a modern man (centre) and a gorilla (right). The recent discovery at Lake Rudolf, Kenya, of the remains of an australopithecine who lived more than half a million years before *Zinjanthropus,* at the same time as a *Homo*-like creature, has completely upset earlier theories, writes Dr. Leakey. "Most textbooks", he says, "still place the genus *Australopithecus* (including *Zinjanthropus*) in the direct line of ancestry of the genus *Homo,* and therefore of *Homo sapiens.* This view can no longer be scientifically maintained".

East Africa today figures very prominently indeed in the story of the evolution of the direct ancestors of man himself, as well as of his nearest cousins—the great apes—and although this article will mainly be concerned with the end part of the story, from about 3 million years ago onwards, it must begin by discussing briefly the discoveries of the Miocene period, which began about 20 to 25 million years ago.

In spite of the fact that Darwin, more than 100 years ago, ventured to predict that one day it would be found that man had originated in Africa, few people believed him and it was only in 1924 that the first indications were obtained that, in fact, Africa had very early fossil primates.

The story begins with a discovery made by Doctor, H.L. Gordon, who was living at Koru, in Kenya, and engaged partly in farming and in a limited medical practice. Because of his early training and interest in zoology he began to notice that following the ploughing of the land of his farm and on subsequent washing of the ploughed soil by rain, fragments of fossil bones and teeth were visible and he began to collect these and submitted them to Mr. E. J. Wayland, the Director of the Geological Survey in Uganda, and to me in 1926 in Nairobi. We both realized that Dr. Gordon had made a very important discovery and thus, through the accident of having a doctor as well as a farmer at a critical place, began the long series of discoveries.

Since those early days, East Africa has yielded a vast collection of fossils of Lower and Upper Miocene age, among which are more than 500 fossils representing the higher apes and also examples of Proto-man. A similarly important early discovery was made in the same year, 1924, at Taung in South Africa when a student brought a fossil specimen to his professor of anatomy at the Medical School in Johannesburg. This proved to be the first discovery of a "near-man" or australopithecine. Thus, 1924 was an important year for the African continent. As will be seen in this article, discoveries followed thick and fast.

During the early Miocene period East Africa was inhabited by a number of higher primate forms, among which were true ape-like creatures such as *Proconsul africanus*—at one time regarded as in the direct line of ancestry of man—and also ancestral forms of the gorilla, chimpanzee and gibbon as well, possibly, as an ancestral orang-utang.

Living side by side with these extinct apes in East Africa, at that remote period, was *Kenyapithecus africanus* who is regarded by me, and by many of my colleagues, as in the direct line of ancestry of man and the "near-men". This view is not universally accepted, but the evidence is very strong. In any event, *Kenyapithecus africanus* is much more similar to a possible ancestor of man than the other primates which were contemporary and listed above.

By the Upper Miocene period around 12 million years ago, the evidence from East Africa is much more definite. At Fort Ternan, an Upper Miocene site in Kenya, we have found fossils of a proto-man named *Kenyapithecus*

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Photo Hugo Van Lawick © National Geographic Society, Washington D C.

Olduvai gorge: peephole into prehistory

Olduvai Gorge, Tanzania, above, contains one of the world's richest hoards of fossils and has been the scene of momentous discoveries by Dr. Louis Leakey and his wife Mary. Above right, Dr. Leakey holds the broken molar of a Dinotherium, an extinct, tusked mammal. On his hat he cradles a tooth from an extinct elephant. Left, scientists look on as Leakey points out the layer in which "Zinjanthropus" was found. The first clues to the existence of "Zinjanthropus" were his huge teeth and fossilized palate, right.

Photos © National Geographic Society, Washington D.C.

wickeri, whose remains are so similar, morphologically, to *Ramapithecus* of India, but a little older in time, that some authorities consider the two species to be identical.

That question can only be settled when more specimens are found. In the meantime, what is certain is that in the *Kenyapithecus wickeri* specimens we have a primate with a large number of hominid characters and one which is universally accepted as a hominid or man-like creature, not a pongid or member of the ape stock.

Not only does *Kenyapithecus wickeri* have physical characters such as small canine teeth, shovel-shaped incisors, rounded mandibular arcade and a short face, which are all hominid characters, but he was also using stones to break open antelope skulls and limb bones, in order to obtain the brains and marrow. The evidence for this statement lies in bones and skulls with depressed fractures and one stone exhibiting evidence of having been used to batter bones. In other words, an Upper Miocene ancestor in Kenya, around 12 million years ago, was already extending his food beyond mere plant products to include animal proteins.

It was probably this widening of his food resources that enabled the descendants of *Kenyapithecus wickeri* to survive, when *Proconsul* and many of the other primates, at this time, became extinct. Although it is not possible to say that *Kenyapithecus wickeri* must be the ancestor of *Homo sapiens* it would certainly seem likely that he represents the stock from which all man, and man-like species eventually emerged.

IN 1931, during my Third East African Archaeological Expedition, we recovered a fragmentary mandible in a highly fossilized condition at Kanam West on the shores of the Kavirondo Gulf of Lake Victoria, Kenya. The specimen was highly mineralized and derived from deposits of Lower Pleistocene age, as determined by the fauna. It had been badly damaged before being embedded in the deposits in which it was found, and the lower margin was missing. I described it as *Homo kanamensis* and further indicated that it had many similarities to *Homo sapiens*. With very few exceptions, my colleagues refused to accept the evidence that this specimen was of Lower Pleistocene age, but I never retracted from my stand, because I knew the evidence was sound.

It was also during the Third East African Archaeological Expedition in 1931 that I and my colleagues discovered that the famous Olduvai Gorge was very rich in early Stone Age cultural remains.

The original discovery of Olduvai Gorge itself was entirely accidental

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'I almost trod on a half exposed fossil skull'

and dates back to 1911, when a German butterfly collector, Dr. Kattwinkel, was chasing a butterfly across the eastern corner of the Serengeti Plains. He was so intent on making his catch that he nearly fell to his death over the edge of the Gorge. Having lost his butterfly and escaped with his life, he climbed down the sides of the cliff and found some magnificent fossil bones of a three-toed horse, which he took back to his colleagues in Berlin.

In 1913 a German expedition was sent out to examine the place where these few fossil bones had been found and discovered a wealth of extinct animal remains. Thus, again, an accident led to the discovery of what is now, probably, the most important site of fossil human remains anywhere in the world.

Even though I and my colleagues studied Olduvai Gorge from 1931 onwards and obtained wonderful collections of artifacts and fossil animals, we did not find the first significant fossil human skull until 1959. This was the discovery of *Australopithecus (Zinjanthropus) boisei.*

DURING the past two years my son, Richard Leakey, has been conducting intensive palaeontological and archaeological research at the north east end of Lake Rudolf and he has found clear evidence of the genus *Homo* represented by a number of specimens. These are completely contemporary with the fossil fauna, similar, in most respects, to that from Kanam West and undoubtedly of Lower Pleistocene age. Although Richard Leakey's new *Homo* finds have not yet been given scientific names, their similarity to the original Kanam mandible is most striking, but Richard's specimens are much more complete.

An interesting fact, in connexion with the discoveries at East Rudolf, is that in the same series of deposits there also occur magnificently preserved remains of a robust australopithecine, who was contemporary with *Homo*, and which are more than half a million years older than *Australopithecus (Zinjanthropus) boisei*, from Olduvai. There is, therefore, clear evidence from Kenya of a Lower Pleistocene form of the genus *Homo*, which is completely contemporary with the australopithecines in Lower Pleistocene times.

These facts inevitably lead us to a brief discussion on the australopithecines as a whole. Most of the existing textbooks still place the genus *Australopithecus* (including *Zinjanthropus* and *Paranthropus* and other comparable forms) in the direct line of ancestry of the genus *Homo*, and therefore of *Homo sapiens.* This view can no longer be scientifically maintained.

Undoubtedly, of course, the australopithecines and *Homo* must have a common ancestor, somewhere in the scale between the Upper Miocene and the Lower Pleistocene, but such a common ancestor has not yet been found. The fact, however, that a very robust australopithecine with a number of over-specialized characters existed in the Lower Pleistocene some 2½ to 3 million years ago, and was contemporary with *Homo*, completely destroys the view that *Australopithecus*, as such, is our direct ancestor. When a common stock from which these two types of hominid are derived is eventually discovered, it will probably have some characters of both, but clearly be distinguishable from either.

It is interesting to note, here, that in the deposits at East Rudolf of Lower Pleistocene age which have now yielded numerous specimens of *Homo*, there are stone artifacts which are very closely similar to the three found *in situ* at Kanam West with the Kanam mandible. These were published in my book "The Stone Age Races of Kenya". The preliminary notes which have been published concerning the East Rudolf artifacts show clearly that the genus *Homo* was making several different types of stone tools, during the Lower Pleistocene in that area.

At Olduvai Gorge a little less than two million years ago, we have found further very significant evidence relative to the origin of the genus *Homo* and, therefore, of *Homo sapiens.* In Bed I at Olduvai in 1959 we discovered a very well preserved skull of an australopithecine which we described as *Zinjanthropus boisei.* At the time of the discovery no other hominid remains were known from Olduvai Bed I, while we had much evidence of the Stone Age culture known as Oldowan in these deposits.

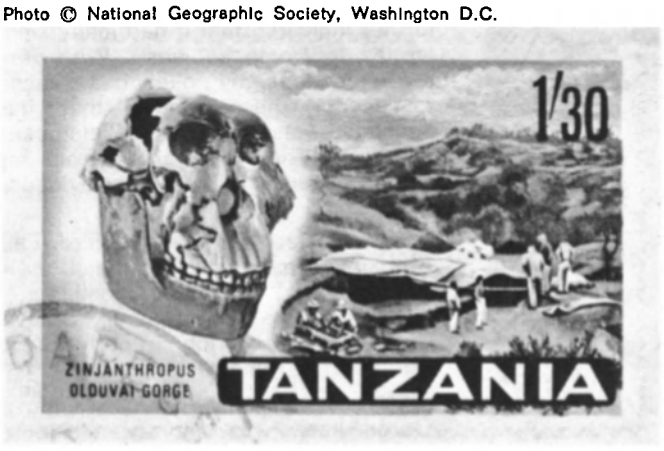
Although, therefore, it was accepted that *Zinjanthropus* was an australopithecine, in its physical morphology, it seemed posible that it might qualify as a "man", in view of the current definition of "man" at that time—"Man the Tool-Maker". A few months later the first fragmentary fossils of what is now called *Homo habilis* were found in deposits of the same age as *Zinjanthropus* and also in association with the Oldowan culture. Since then, many further specimens of this second type of hominid have been found at Olduvai and published in *Nature* and elsewhere, as it is clear that they represent the genus *Homo*, living during the Lower Pleistocene.

A full description is in preparation at the present time, in monograph, and there is no doubt whatsoever that the morphology of *Homo habilis* is much more similar (at least in respect of the cranial vault) to *Homo sapiens* than are the fossil remains of *Homo erectus*, the extinct hominid species first found in Java and China and later in Africa in Middle Pleistocene deposits.

THERE seems very little doubt that *Homo habilis* lies in the direct line leading to *Homo sapiens.* In all probability the branch which ended up as *Homo erectus* diverged from *Homo habilis* at least as far back as the Lower Pleistocene, in view of the fact of his presence, in the Far East, as a fully distinct and over-specialized species in the Middle Pleistocene.

Another accidental discovery of the greatest importance took place in 1961—the find of remains of the same type of man as in China and Java, but twice as old in East Africa as in the Far East. This time the accident was due to an error on the part of one of my staff. The geologist working with me returned to camp one day with a draft plane table map of a certain part of the Gorge. I looked at it and said, "But you have left out one long narrow side gully." He replied, "I have not", and I said,

Photo © National Geographic Society, Washington D.C.



Tanzanian stamp issued in 1965 in honour of the first famous find at Olduvai Gorge.

Photo Hugo Van Lawick © National Geographic Society, Washington D.C.

With his smooth, sloping brow and canine teeth smaller than those of most apes, though larger than man's, "Proconsul Africanus" was once thought of as a possible common ancestor of apes and hominids.

"I am very sorry, but you have; come over with me tomorrow morning and I will show you."

When we got to the long and rather grass and bush filled gully, and he had had to admit that he was in error, I looked back towards our camp site and suddenly on the far side of the Gorge I saw a very small area of exposed fossil beds. These were on the north side of the tongue of land which separates the main and side gorges.

Although I had explored Olduvai on foot since 1931 I knew, at once, that I had never set foot in that tiny exposure. But for the error on the part of my student which had taken me back to the point from which I saw it, I might still never have seen it. It was only visible from that one point of view. As soon as we got back to camp, I went off again to locate this hidden patch of exposures, and as I walked on to it I almost trod on a half exposed fossil human skull. That was the first *Homo erectus* skull from Olduvai.

This brings us, inevitably, to a discussion of the further textbook view that *Homo erectus* is a direct ancestor of *Homo sapiens.* This view, too, can no longer be taken seriously for the following reasons:

The shape of the cranial vault of all specimens of *Homo erectus* is quite dissimilar to the cranial vault of *Homo sapiens* while, as already stated above, the shape of the vault of *Homo habilis,* which is much older in time, is very similar.

Homo erectus exhibits a large number of highly specialized characters which are present in the African and Far Eastern variants while *Homo habilis* has many more *Homo sapiens* generalized features.

The pelvic bone of *Homo erectus* found in Olduvai Gorge and published recently, and the femur shaft associated with it, are clearly of a quite different type from the corresponding bones of *Homo sapiens* and it begins to look doubtful whether the Trinil femur truly belongs to *Homo erectus.*

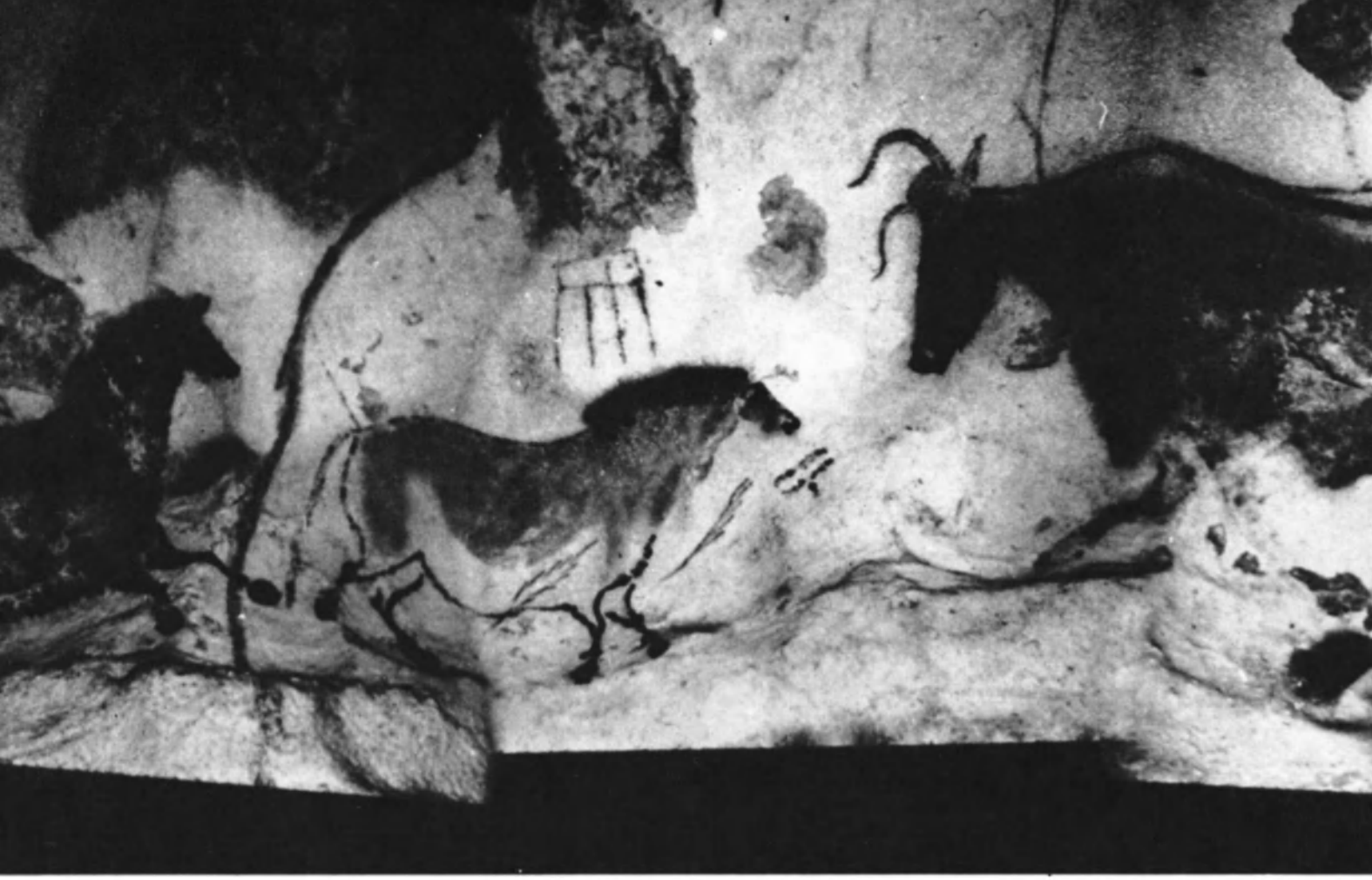
When we go on, therefore, to discuss the emergence of *Homo sapiens,* in the light of the evidence available in 1972, it becomes entirely clear that we have to revise our total picture of how our species came into being.

THERE can be no doubt now, at all, that *Homo sapiens* was present in the Middle Pleistocene times in both Europe and Africa; a fact which was accepted at the Unesco sponsored Conference on the origin of *Homo sapiens,* in Paris, in 1969, when specimens such as the skulls from Kanjera, Swanscombe and the new Kibish specimens from southern Ethiopia were unanimously accepted as representing *Homo sapiens* in a primitive form, but quite distinctly sapiens. In fact this species was present during the Middle Pleistocene times in areas as far apart as Swanscombe in England and Kanjera in Kenya. It is obvious, therefore, that an earlier form of *Homo sapiens* must occur somewhere in older deposits.

When the fragmentary Kanjera skulls were found deriving from Middle Pleistocene deposits and in association with hand axes in 1932, they were rejected, much as the earlier Kanam mandible was rejected, and were placed in what was called a "Suspense Account". When the Swanscombe skull, in its turn, was described in 1936 as *Homo sapiens,* it was rejected because it seemed too old for that species. It was only when the southern Ethiopian skulls from Kibish were discovered in 1967 that a new concept of the antiquity of *Homo sapiens* began to crystallize, and become accepted.

To conclude this discussion we may, perhaps, be permitted to try and distinguish between *Homo sapiens sapiens* (what is known today as psycho-social man) and *Homo sapiens faber*—early tool making members of our species who had not yet achieved full psycho-social status.

I believe that the beginning of psycho-social man probably coincides with the dawn of art, religion, magic beliefs and speech in terms of abstract ideas as distinct from mere words describing material objects. By this time too man had begun, perhaps, to be a community dweller as shown by the vast accumulations of his artifacts in the caves of the Dordogne and elsewhere during the Upper Pleistocene times. ■



Cave wall art comes to man

by
André Leroi-Gourhan

THE contemporary arts of Africa and Oceania are often mistakenly labelled "primitive"—a serious error since these arts have had just as long an evolution as western art. Traces of this evolution have all too often vanished, yet those that survive prove that styles varied over the centuries and that, although their "language of forms" differs from that handed down to us from Ancient Greece, the so-called "primitive" arts are in no sense rudimentary.

The same cannot be said for the oldest prehistoric art whose first expressions can be perceived at the dawn of modern man. This is the true primitive art.

As other articles in this issue make clear, the concept of humanity changes according to whether we consider man within the span of history or within the context of the modern age.

In the modern context we find a single global concept of man; *Homo sapiens*, symbolizing the human race. But within the span of history, things are quite different. For one or two million years, perhaps even longer, thousands of generations of bipeds succeeded one another, and *Homo sapiens* emerged perhaps less than fifty thousand years ago.

Along this interminable road of early human development we encounter relatively few works of art.

ANDRE LEROI-GOURHAN *is one of the outstanding world authorities on prehistoric art. He is professor of prehistory at the Collège de France and director of the Institute of Ethnology in Paris. He has directed many archaeological excavations in Europe and the Far East. He took part in Unesco's 1969 international symposium on the origin of* Homo sapiens, *in Paris (see bibliography inside back cover).*

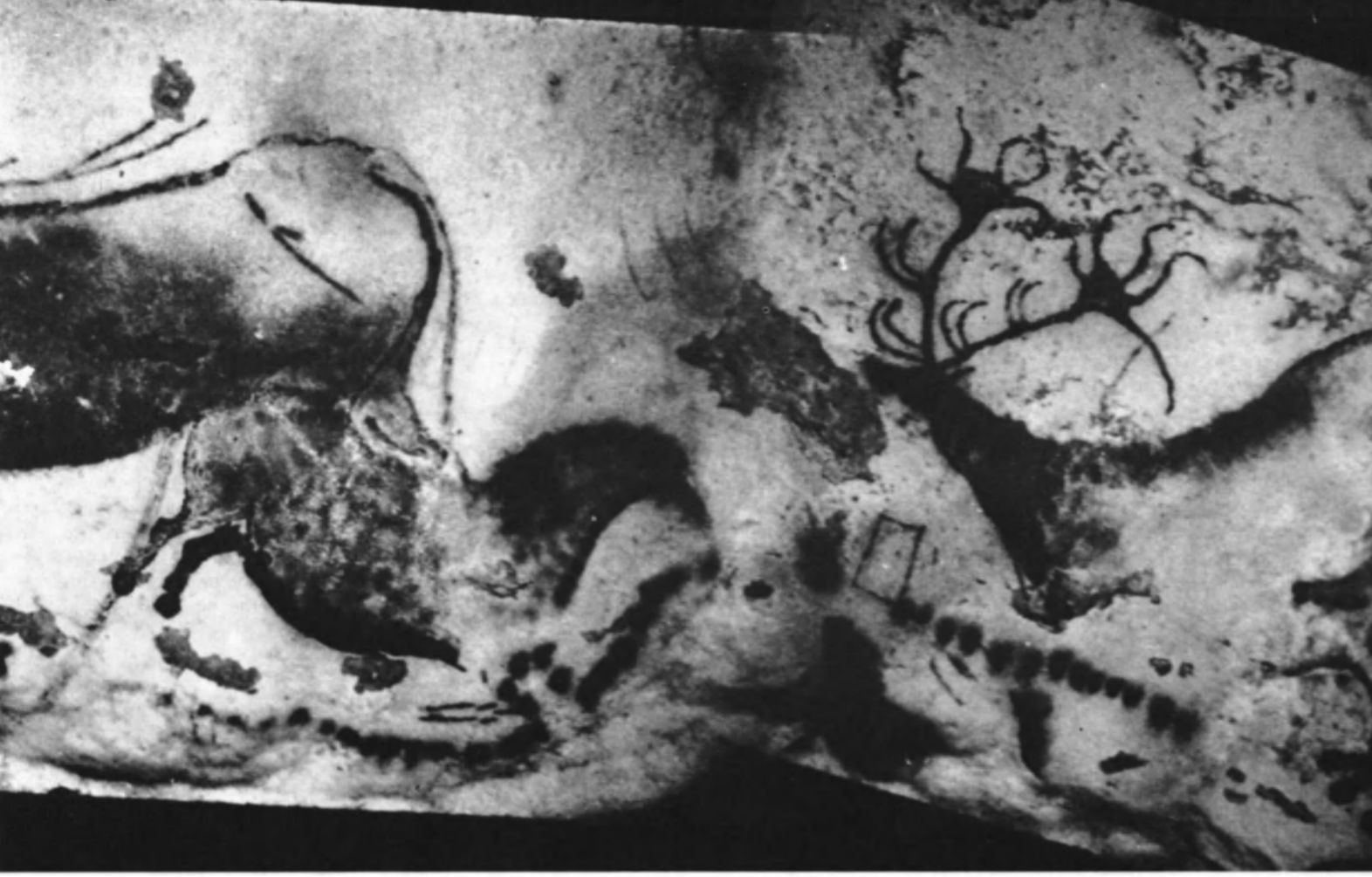


Photo © Jean Vertut, Paris

The cave of Lascaux in S.W. France boasts some of the finest prehistoric art of the Magdalenian period (15,000-9,000 B.C.). Cave artists, who depicted hundreds of vigorous and lifelike animal figures on its walls and ceiling, knew the animals around them intimately, and displayed an extraordinary understanding of and skill in painting by contrasting black, brown, red and yellow paints to enhance the realism of their work (see back cover). Horses in this Lascaux fresco (centre, beneath a leaping cow, and at far left) have been called "Chinese" because of their similarity to horses seen in Chinese art 15,000 years later.

At best, one can imagine the predecessors of modern men, while their intellect gradually evolved, indulging an occasional aesthetic impulse by using their voices, beating out rhythms and making body movements, the precursors of song, music and dance.

As one approaches the types of men nearer our own—Neanderthal man for instance—one can add to these embryonic forms of artistic creation the first signs of engraving, painting and sculpture.

No structured and decipherable work of art from these very distant times has yet been discovered, but we do know that between 40,000 and 100,000 years ago Neanderthal men handled natural red ochre and may even have scratched lines on bone fragments with the point of a flint.

Unfortunately, there is little to help the prehistorian to understand how the arts were born: only a few traces of pigment to attest that men were already interested in colour. Sometimes, too, the odd-shaped stones and fossilized shells found among the used flint tools and remains of game in early settlements show us that our nearest forefathers were intrigued by the spontaneous forms of nature. This attraction for "natural curiosities" is deeply anchored in the aesthetic behaviour of man and has survived all through history, right up to our own times.

That Neanderthal men, or the type of humanity just preceding our own, had aesthetic needs, as well as the means of satisfying them, is shown by the already advanced state of their technical skills. The shaping of stone tools creates forms which quickly acquire regular outlines (ovals, blades with nearly parallel sides, triangles, and so on). The first production of such artificial forms was dictated by the technique used to prepare the flint blocks from which the efficient tool was to emerge.

Although it has been shown that chance fragments of split flint can be used as tools, we perceive, during the first million years of human prehistory, a search in progress for processes which would enable artifacts to be standardized. We find, too, a gradual evolution of styles which enable us to identify objects from different periods.

The search for efficient tools and the need for an economical use of whatever raw materials came to hand are the obvious explanation for this evolution in tool-making. Yet the truly significant fact is that this increasing technical progress is inseparable from the growing elaboration of aesthetic forms.

However, until about 40,000 B.C. one cannot really speak of true works of art—works in which the hands of men created not merely an object but also a symbol.

It is difficult to draw clear lines of demarcation between the successive stages of man's evolution since, in a theoretical sense, they are not those of pre-men, proto-men and finally true men. From the very beginning we are dealing with men who gradually

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became more and more human, right down to modern times. The same is true for art which did not suddenly appear fully formed, but evolved gradually through the ages. Neanderthal man's interest in the curiosities of nature or in pigments, therefore marked a decisive phase in a continuous process which reached its full development later.

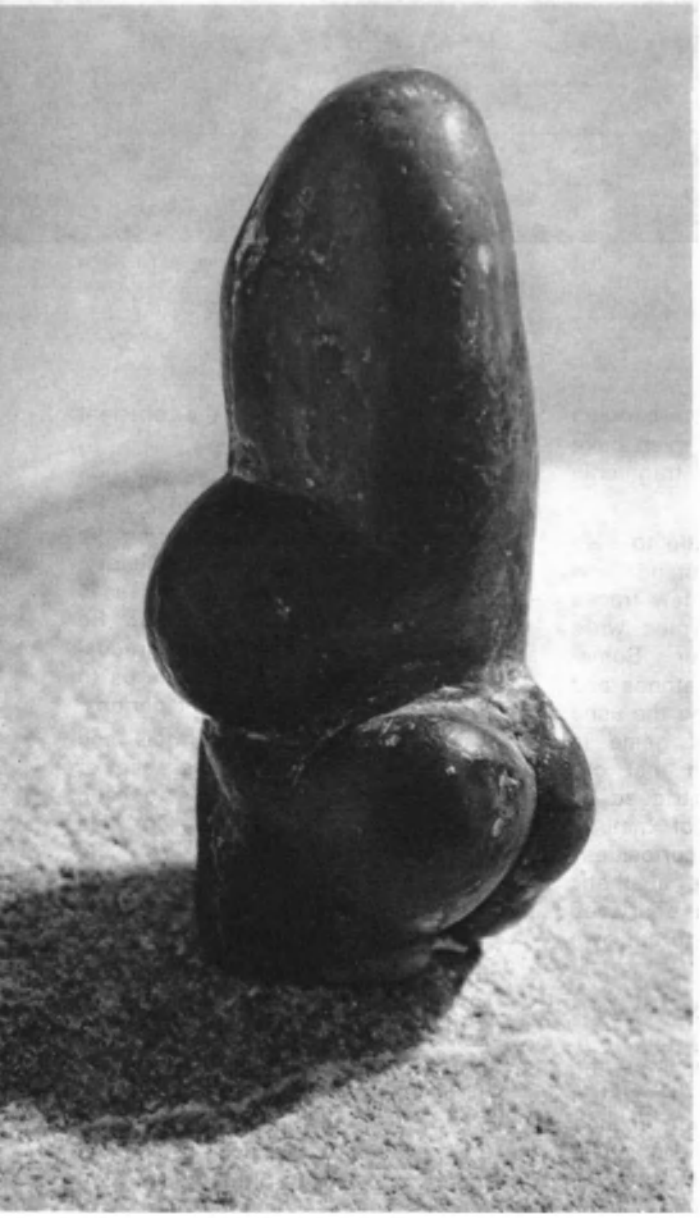
This development, reflected in the nature of modern men, is in all probability linked with the emergence of language, or at any rate, the capacity to formulate abstractions. The hand, like the vocal organs, faithfully expresses thought. And although it is true that until the appearance of writing we have no direct witness to verbal expression (which stems from the same cerebral centres as manual expression), nothing prevents us from supposing that language and technical skill were interdependent all through human evolution.

But if from the beginning the hand gave form to thought through the craftsman's gestures and left a permanent "memory-print" of the unconscious search for forms, no trace of any consciously created shapes with a symbolic rather than practical function has been found among the remains of the men who lived between 500,000 and 1 million years ago.

What the hand did not translate is not likely to have existed in the language; and it seems that any change had to wait until the long process of cerebral and cultural development reached a certain threshold. *Homo sapiens*—the present human species—crossed that threshold some forty thousand years ago.

Strikingly enough, ornaments (pierced teeth and pendants) appeared at the same time as the first attempts at figurative art. It is as though the emerging modes of expression translated at the same time the symbols of social behaviour (ornaments) and the symbols of abstract expression—which confirms the link between artistic and verbal expression. The aesthetic impulse is always the carrier of social yearnings, in the fullest sense. It does not exist for its own sake because it is a means of expressing or giving form to feelings of power, love or religious aspiration.

So far as one can judge, the ornamental or figurative prehistoric arts obeyed the same rules as later arts. The exact date of their emergence is difficult to fix, partly because we are far from knowing the prehistory of all



Photos © S. Celebonovic, from "Préhistoire", published by Editions Eidos, Geneva, and Editions des Deux Mondes, Paris

32 **Two tiny statuettes carved by artists of the Aurignacian period (30,000-25,000 B.C.). The one above measuring only 37 mm. (1 1/2 in.) was discovered at Lake Trasimeno (central Italy). Right, the famous "Venus of Willendorf" (Austria) is 110 mm. (4 in.) high.**

Photo © USIS

Photo © S. Celebonovic, Geneva

Prehistoric artists rarely portrayed the human face. Inside front cover depicts one. Two others are shown here. Above, human head carved on a limestone pebble no bigger than a hen's egg. Believed to date from about 20,000 B.C. it was unearthed at Aq Kuptuk in northern Afghanistan. Right, a head carved in ivory 47 mm. (2 in.) found at Dolni Vestonice (Czecholovakia).

the regions of the world, but above all because we are dealing with an evolutionary period, not a particular moment in time. Behind innovation there is always an inventor; but behind the inventor looms a whole social and historical background. And when, as in the present case, the facts cover many small stages spread out over thousands of years, it would be an oversimplification to speak of the "invention" of painting or sculpture.

Our knowledge covers the final period of European Neanderthal man and the end of the last glacial period —perhaps from 50,000 B.C. and certainly up 9,000 B.C. The beginnings were extremely slow; and more than half the period was gone before the creation of the great paintings or low-reliefs of the western European caves.

During the second half of the period, however, there was an extraordinary abundance of decorated caves in Spain, France, Italy and even the Urals, and a profusion of sculpture and engraving all the way from the Atlantic to Lake Baikal in Siberia. Works from this long initial period of artistic evolution will certainly be discovered in other parts of the world. But up to now the thousands of paintings and engravings discovered in Africa or southern Asia, for instance, belong to more recent periods. This does not, of course, make them any less valuable or significant.

A very important point should be noted concerning prehistoric art: its technical means reached their fullest development from the very beginning. This is something that radically distinguishes artistic creation from technical invention. Hunting, fishing, weaving, clothing and home-making skills slowly evolved up to the present. One cannot imagine prehistoric man inventing the aeroplane on the basis of the scientific knowledge offered him by his own society. But with coloured earths and with flint tools whose cutting power is superior to most metal ones, the artist was immediately in possession of all his means of expression.

Time brought new processes like mosaics or oil painting, new colours like greens or blues, as well as various nuances in the execution; but from the very first the artist could give his whole measure in forms, in contrasts of colour and in relief . . . The position is therefore very different for art than for technology.

In technology, the factor of the prehistoric craftsman's creative ima-

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HORSE'S HEAD IN MINIATURE

Carved with superlative skill and minute precision by an artist of the Magdalenian period on a tiny piece of reindeer antler, this horse's head measures only 45 mm (2 in.) from ear to muzzle. It was found in a cave at Mas d'Azil (south-west France).

Photo © S. Celebonovic, Geneva

gination can be disregarded when one considers the material equipment at his disposal. His level of achievement corresponds to the stage at which his society has arrived, according to its period and geographical situation.

For art, the dependence on the technical and social environment is of another order. Crude works and those which reach full mastery of expression can be found in the same society, simultaneously or successively.

Where engraving and sculpture are concerned, the problem of tools does not arise. Flint is perfectly adequate whether for cutting or carving bone, lumps of soft stone or the walls of caves and rock overhangs. And it is even easier to trace shapes with a finger on wet clay or to model them in the same material. So such works are found from the beginning. Modelling and sculpture in low-relief do not appear until relatively late, however, probably not before 15,000 B.C. But the search for "three dimensional" effects is a dominant trait in the evolution of prehistoric art.

In the case of "hollowed out" works of art, one point deserves special mention. For practical reasons, low-relief is only found in hollows lit by daylight. The designs must have taken many weeks to execute; and in deep caves this would have required some form of lighting, as well as prolonged stays underground.

But in some caves (for instance at Font de Gaume in the Dordogne), one comes across an expeditive process for rendering relief which reveals the use of an astonishing technical knack. After the figure has been traced with a line a few millimetres deep, the inner border has been rounded off, and with side lighting this gives a striking illusion of relief.

APART from wall figures, prehistoric artists have left numerous engravings on stone tablets or bones and antlers. Certain objects like the tips of weapons are decorated with simple geometrical patterns; and spear throwers often bear highly elaborated animal figures.

Small sculptures in the round in the form of human and animal figures were also made. In certain regions, such as Czechoslovakia or the U.S.S.R., where cave art is unknown, hundreds of statuettes carved in soft stone or modelled in clay have been found, while female figures, generally with

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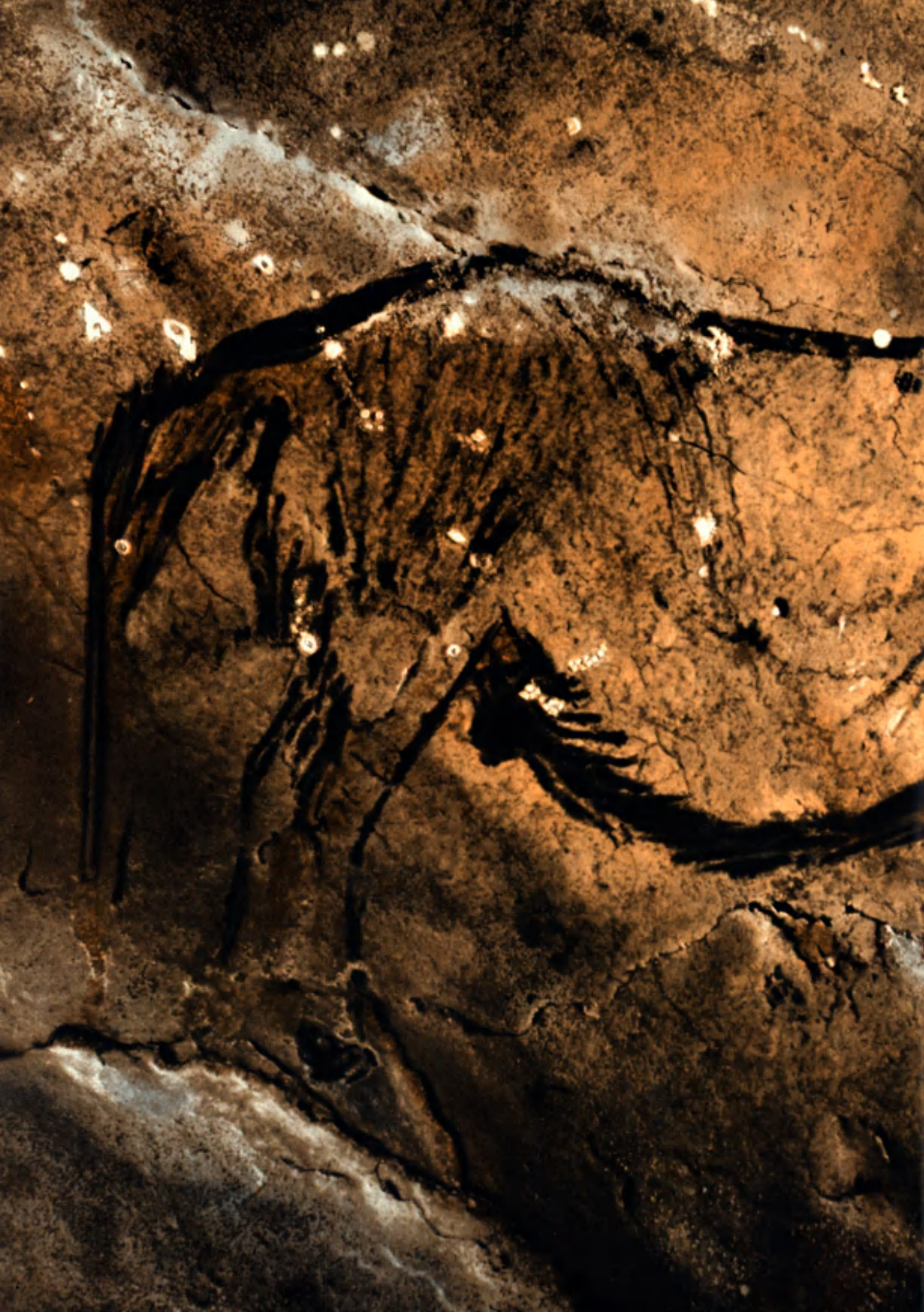
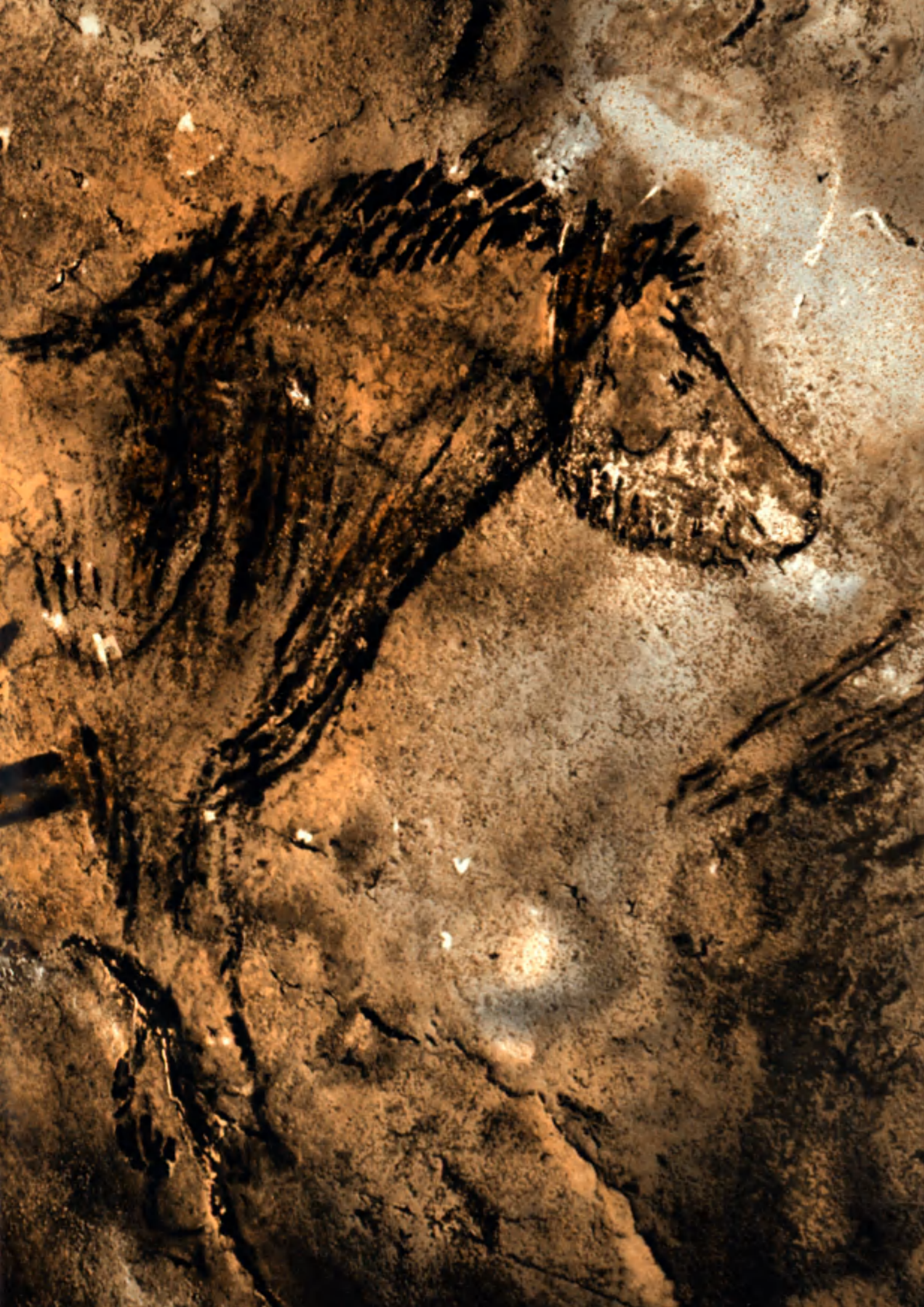
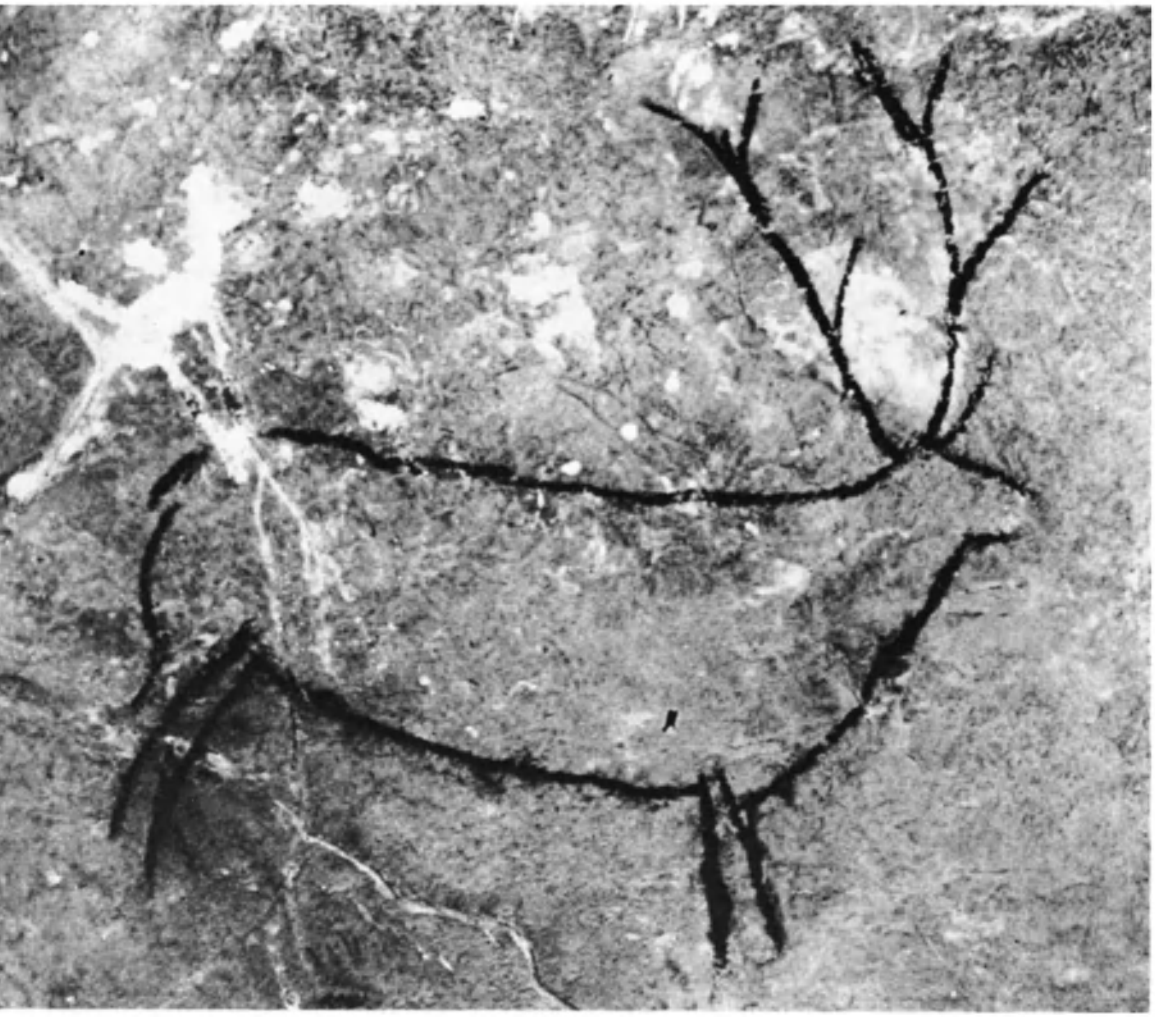
CAVE WALL CAVALCADE. Cavalcades of animals painted in Palaeolithic times on cave walls and ceilings vividly illustrate how hunting dominated the life and imagination of prehistoric man. The meticulous portrayal of horses and reindeer, chamois and bison, lions, bears, mammoths and other animals shows that they were the work of experienced artists. This shaggy-haired mammoth figures on a painted panel of beasts in the Pech-Merle cave in the Lot Department of south-west France. The painted horse (centre spread, overleaf) from a cave at Niaux (S.W. France) is outstanding for its lifelike representation. Note how the artist has imitated flow of the mane by skilful use of sloping lines.

Photos © Jean Vertut, Paris







ART OF PREHISTORIC SPAIN

The artists of prehistory depicted many kinds of deer. Left, antlered stag (40 cm. long) on the wall of the famous Las Chimeneas cave near Santander (northern Spain). Below, a red-painted doe from the Covalanas cave in the same area.

Photos © Jean Vertut, Paris

The palette of the Palaeolithic painter

greatly exaggerated forms, are common from the Atlantic coast of the Pyrenees to Lake Baikal in Siberia.

The development of painting is equally remarkable. As has been shown, colours were in use very early on. By 35,000 B.C., prehistoric man knew how to employ fire to oxydize natural ochres and change their shades; and the whole range of yellows and purplish reds was known and used. Black was supplied by natural manganese or charcoal.

TECHNIQUES for applying paint were no less varied. When the ochre or manganese was sufficiently firm and friable, true crayons were cut, which served to decorate flat surfaces. Hard colours were ground on a palette of rough stone; and both these and natural powders were applied in various ways according to the nature of the background or the effect sought after.

Sometimes the pigments were stippled in close dots, dabbed on with the tip of the finger or printed with a small stick; sometimes continuous lines of varying width were drawn in the same way or even with true brushes.

Occasionally, a special method was otherwise have discouraged artistic efforts. The most striking case is the main part of the Lascaux grotto (Dordogne, France). The surface of the white calcite walls is lumpy, like a cauliflower, and ill-suited to the usual painting techniques.

The Lascaux artists, some 15,000 years ago, solved the problem by stencilling on the powdered colours with the help of a fur pad, giving a dappled effect. As these blurred dabs made it difficult to obtain a clear outline, the painter masked the outer edge of the figures with a strip of bark or leather, moving it along as he advanced.

This extremely ingenious process required considerable manual dexterity; and it confirms the feeling one has when one studies the great artistic achievements of the French and Spanish caves: the fresco artists must have been specialists, at least part of whose activity was devoted to decorating underground sanctuaries.

As was mentioned earlier, the most original aspect of prehistoric cave wall art is perhaps the search for a three-dimensional effect. As well as low-relief sculptures and carvings with rounded inner edges, two other techniques were developed.

The first is common to the various painting and engraving processes. It consists in taking advantage of natural irregularities in the wall by placing the work in such a way that a bump is used for a flank, the edge of a rock for a bone or a small knob for paws —with colours or engraved lines stressing the natural volumes and making them explicit.

The second solution is to vary the thickness of the line or use shading or hatchings. This method is used with great skill at Altamira near Santander, in northern Spain towards 11 or 12,000 B.C. and at Niaux (Ariège, France). It puts the frescoes in the depths of these caves on a level with the finest works produced by the great artists of historical times.

Can one indeed justifiably describe as "primitive", an art which already has thousands of years of development behind it? It is reassuring to remind ourselves that at a time when technology was rudimentary and human life still at a subsistence level, thousands of years before agriculture, metal-working and writing brought into being the civilizations of antiquity, man had found ways of giving full expression to his artistic thought and by the same token to his humanity. ■

Photo © Giraudon, Paris

Ancient rock carvings have been found in many parts of the world. This rock engraving is from Lake Onega, 200 km east of Leningrad, where archaeologists have uncovered numerous traces of Neolithic peoples who lived on the lake's shores and islands: tools, and rock-cut animal figures including many reindeer.

The long journey of the primates

by John Napier

THE story of man and his ancestors is like a play in which the key character does not appear until the last scene. Yet by the time he finally makes his entrance the audience has already got a very good idea, from what has gone before, of the sort of person he is going to turn out to be.

To say man is the "key" actor in the drama of primate evolution, of course, is to take a very biased view. There is no doubt that if this article were being written by a giraffe, for example, man might find himself allotted a very minor and probably most obnoxious part in the evolutionary saga of the primates. It is natural that man should be self-centred in his approach to primate evolution but that does not mean that he is not capable of thinking in any other way.

Many of my zoological colleagues, for instance, are principally interested in analysing the background of the non-human primates, the lemurs, monkeys or apes. But I am an anthropologist which means that man is the central theme of my research so it is not surprising that I am primarily interested in the appearance of those structural and functional features by which we characterize man today. This being so we must clarify our ideas and decide just what we should be looking for in the primate fossil record.

First of all we must examine the nature of our criteria and select those characters that are unique to modern man and can truly be called his "hallmarks" (*). There are quite a number of characters that we might choose but, bearing in mind that our source material is limited to fossil bones and teeth, the range is naturally rather restricted. The possession of speech and language is the most outstanding human hallmark of all but unfortunately it leaves no trace in ancient bones.

One can make all sorts of inferences that speech evolved at such-and-such a time but there is no scrap of direct evidence to support such an assertion. The ability to speak lies, first of all, in the shape and musculature of the mouth, tongue, soft palate, pharynx and larynx; and secondly, in the centres of the cortex, or outer shell, of the brain which govern the muscular control of the various "soft" parts mentioned above. Although many ingenious suggestions have been put forward none as far as we know can help us to recognize the capacity for speech from a study of bones.

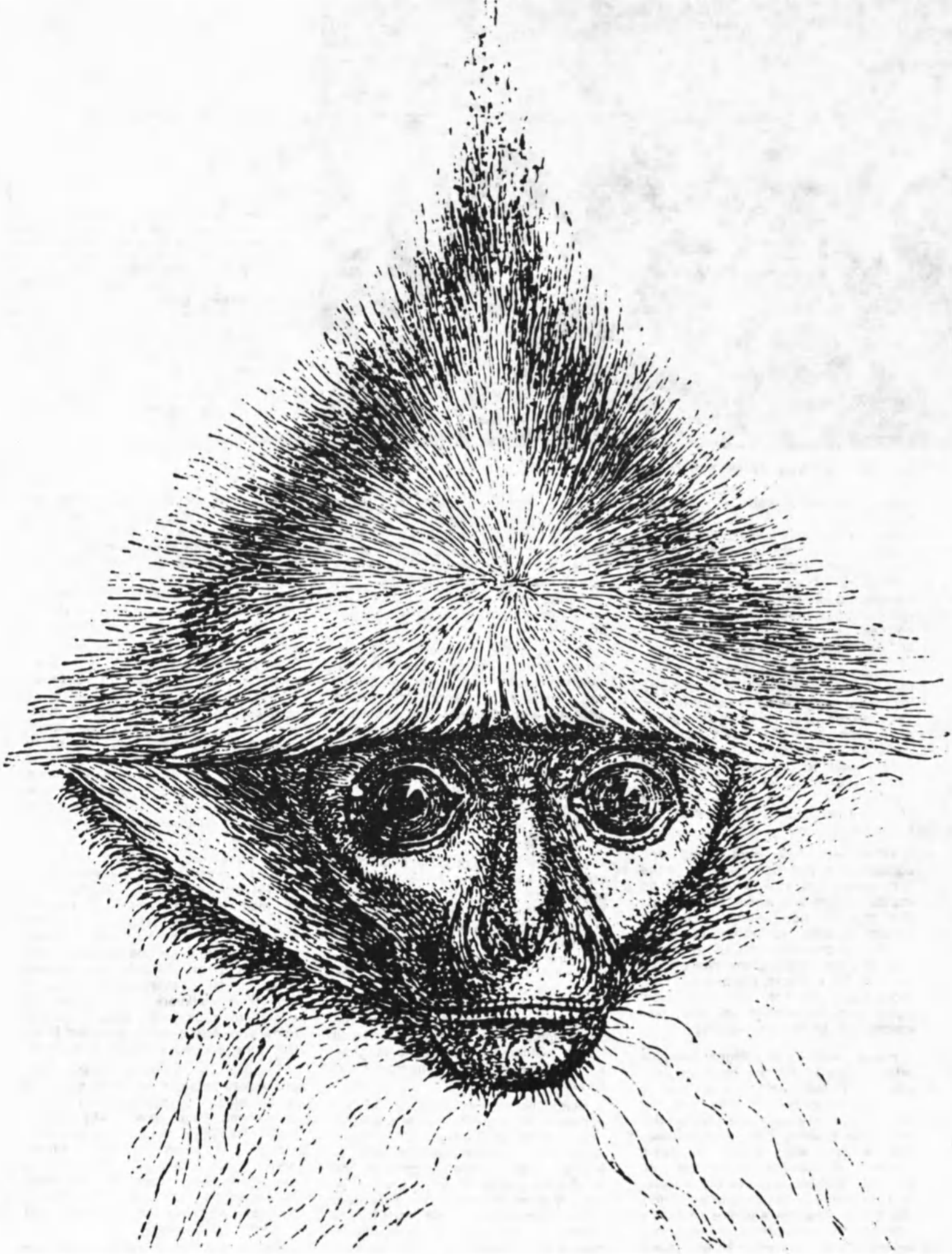
There are numerous cultural phenomena which we would regard as significant hallmarks but, again, we cannot use them because they leave no physical evidence behind. Behaviour itself does not fossilize but the extra-corporeal accessories of behaviour *do*.

Evidence of a hunting economy can be determined from the living sites (or living "floors" as they are called) of early man; in the same way tool-

CONTINUED PAGE 42

JOHN NAPIER *is Director of the Unit of Primate Biology at Queen Elizabeth College, University of London. A leading specialist in the anatomy of non-human primates, he was formerly director of the Primate Biology Program at the Smithsonian Institution, Washington, D.C. He has written several books on the origins of man (see bibliography inside back cover). He is well-known to British TV audiences for his contributions to popular science programmes, and has just completed a book on the Abominable Snowman, to be published shortly under the title "Bigfoot", by Jonathan Cape, London.*

* Hallmarks are stamped on gold and silver objects. Basically they provide a verification of the purity of the metal but they also supply other information such as the country of origin, the date and place of assay and often the identity of the craftsman.



This drawing is taken from the 2nd edition of Charles Darwin's book "The Descent of Man", published in London in 1883 by John Murray. The solemn-faced simian is perhaps bowed down by the weight of his name—*Semnopithecus rubicundus*. Charles Darwin explained the curious hair pattern in terms of sexual selection. "It is inconceivable", he wrote, "that such patterns can be of use in any ordinary way".

Photo © Ralph Morse - Life, New York

Man's debt to the tree

To his ancient ancestors who were tree-living creatures, man owes his mobility of hand, opposable thumb and the upright posture of at least the upper part of his body. Left, Gibbon apes still swing happily from tree to tree, but, like man, the gorilla (right) is now basically a ground-living animal, though his lower limbs have not adapted to true bipedalism and he still supports himself with his knuckles when walking. Through evolutionary changes in the pelvis, man and his ancestors adopted a bipedal, striding gait, better adapted to ground-living. Drawing (far right), the pelvic girdle of *Australopithecus* as compared with that of a chimpanzee.

making behaviour can be identified. Much as a modern picnic site can reveal to an intelligent inquirer all he needs to know about the habits and social status of the picnickers, so living floors of early man with their hearths, their animal remains, their wall-paintings, their burials and so on can be read and interpreted by archaeologists.

Unfortunately the background to man that we are committed to investigate extends many millions of years further back in time when no living floors and no artifacts existed. Apart from the evidence of stone or bone tools as supplements to our understanding of human dexterity we shall not be leaning very heavily on the evidence of "fossil behaviour". What, then, are to be our criteria?

When we think about man and compare him with non-man one of the first things that strikes us is that he stands upright and walks on two legs. But this is not nearly a precise enough definition to exclude the many non-human primates who are also capable of upright bipedalism. Nor does it exclude, for example, the bears. For a more exact criterion we must draw upon our knowledge of the biomechanics of human walking.

Human walking is a highly complex affair. This is not the place to stuff you with technical details like a Strasbourg goose with rich food, but to ask you to accept the simplified—but nonetheless valid—conclusion that modern man shows a unique method of walking which we call *striding*. Striding involves the muscles and the joints of the vertebral column, the pelvis, the leg and the foot in a complicated and precisely integrated series of manoeuvres. An alternative term for striding is heel-toe walking. We are now in a position to formulate our first hallmark: *Man stands upright and when walking habitually uses a bipedal, striding gait.*

The second characteristic that strikes us is the dexterity of the human hand which is infinitely capable, exquisitely delicate but, at the same time, alarmingly powerful—powerful enough to cleave a brick in half with a karate chop, or to tear a city telephone directory into two equal parts.

The essential component of the human hand is its *opposable thumb*, which provides the means for grasping objects with strength (the power grip) or with delicacy (the precision grip). The opposable thumb is therefore an obvious hallmark, but unfortunately it is not unique to man; all living Old World monkeys and apes possess opposable thumbs.

ONCE again we must draw upon our knowledge of the functional anatomy of man's hand to set us on the right track. Man's precision grip is much more sophisticated than any monkey's or ape's; when he places his forefinger and thumb together in a precision grip he is employing the two most acutely sensitive areas in his whole body. The sensory input from these small areas provides the neurological basis for the sort of skill that a watchmaker, a plastic surgeon or an assembler of micro-circuits possesses.

Sometime ago, in order to provide a means of quantifying the precision grip of primates, I introduced a simple ratio called the *opposability index* to express the relative lengths of the forefinger and thumb. The opposability index of men is 65. The score for a chimpanzee is 43 and for a baboon, which approaches nearest to man in this respect, it is 57. So now we are in a position to formulate the second hallmark: *man possesses an opposable thumb whose length is approximately 65 per cent the length of his forefinger.*

The third feature that strikes us about man is that his brain is large and rounded; but of course brains do not fossilize and so we can only make deductions about the brain from the study of its container—the brain-box. Unfortunately, apart from overall shape and size, there is no means of determining the nature of the brain by a simple examination of fossil skulls.

What is more, size itself is a somewhat misleading indicator because it is naturally variable within a species; for example among modern human populations the brain volume ranges from 950-2000 cubic centimetres. The average volume is about 1400 cc. Brain size is related to body size—bigger animals have bigger brains—and, in some way that we don't fully understand, to intelligence.

Nevertheless, brain size is a valuable guide to the palæontologist who is attempting to follow the track of man through time. From the earliest pre-human stages to the final flowering of the human family expressed in the species *Homo sapiens*, a steady trend towards enlargement is seen. Here, then, is the basis of our third hallmark which can be expressed thus: *man, relative to his body size, has a large, rounded brain that may exceed 1400 cc in volume.*

Finally, we notice that man possesses small, even teeth arranged in an elegant parabolic form in his upper and lower jaw. The human teeth, like those of all living primates, are of four types: incisors, canines, premolars and molars. Together in both jaws they total 32, a number characteristic of all Old World monkeys and apes but not New World monkeys or prosimians.

Unlike the apes, man's teeth are all more or less the same vertical length; the canines which form massive elongated and projecting teeth in the apes are small, short and discrete in man. Human molars bear

Drawing from "Man's Place in Nature", by T.H. Huxley, William and Norgate, London, 1883

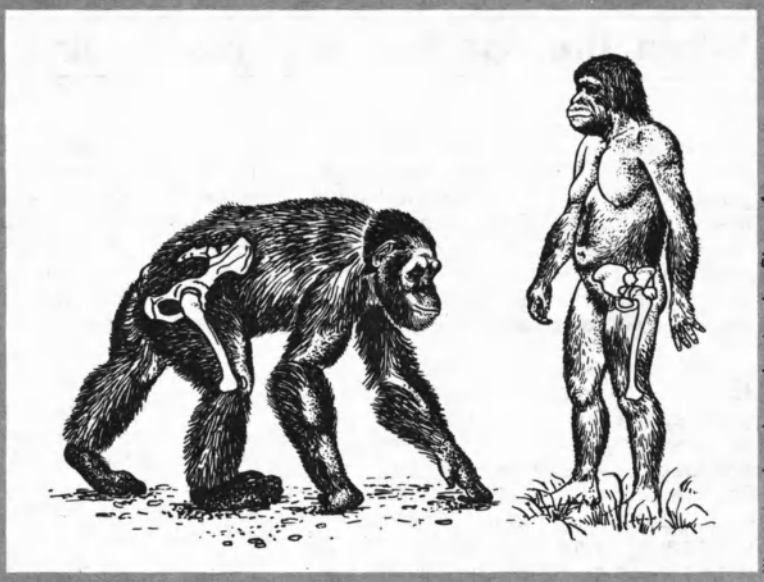


Illustration based on drawing by Singer from "The History of Mankind" © Robert Laffont - Unesco, Paris

low, rounded cusps in contrast to the sharp, prominent cusps of apes and monkeys. The human third molar in both jaws is often small and is frequently absent, whereas in apes the third molar is often the largest of the series.

There are many other differences but these few should be adequate for the purpose of defining the fourth hallmark as follows: *man's teeth are small and are arranged in the jaws in a parabolic curve, the third molar being the smallest of the series and the canines non-projecting.*

WITH these hallmarks in mind we ought to be able to pick up the trail of man during our journey through the past. The trip will be rather like travelling by train between two cities a thousand miles apart. Most railway systems are very complicated affairs with numerous junctions, switching points, branch lines and dead-end terminals, so we have to constantly be on our guard that we do not become shunted along long-forgotten tracks that simply finish up at the end of nowhere at a pair of rusty buffers.

There is a very real danger of this happening because evolution frequently involves a form of mimicry as a result of which similar characters crop up in unrelated or distantly related forms. We have already seen for example that walking on two legs is not uniquely the possession of man. This form of mimicry is more properly termed *parallelism* and the theory behind it is that, given a similar set of environmental opportunities, animals with a common ancestry will tend to evolve in a similar way.

The best example of parallelism in primate evolution is that the monkeys of the New World and the Old World, which are related through a common ancestor living 40 million or so years ago, share so many physical characters that it is hard for the average person to tell them apart even seeing them side by side in a zoo.

Man has a double ecological heritage. His earliest ancestors were tree-living creatures well adapted to moving, feeding, mating and sleeping high above the ground in tropical forests. His later forebears were ground-livers spending their lives among tropical woodlands and grasslands in competition with the myriads of ground-based mammals including the large, predatory, carnivores.

His two phases are complementary; without an arboreal background he could never have succeeded on the ground. He possesses neither the fleetness of the impala nor the killer power of the leopards, cheetahs and lions; but he has, through his arboreal background, acquired talents which were of infinitely greater value.

He could run on the ground *and* he could climb trees; he could evade dangers by subtle manœuvres undreamed of by the instinct-dominated predators and with his emancipated hands he could use weapons and tools to protect himself and to obtain food. Hands were far more efficient than the hooves of his ungulate competitors. Paradoxical as it may seem, man's success as a ground-living primate was entirely due to his arboreal heritage.

The earliest ancestors of the primates were among the first mammals to make their appearance. At this stage, some 70 million years ago, primates-to-be were small, long-nosed, ground-living animals rooting among the leaves of the forest floor for their insect food, and distinguishable only by obscure characters of the teeth and skull from the other long-nosed insectivorous creatures.

With hindsight, some authorities feel they can recognize these primates-to-be even though they possessed none of the *arboreal characters* by which we now recognize the order. They may well be right, but to those of us interested in living primates (including man) the order, effectively, came into being when the primates started to live in trees.

Plesiadapis is a most unprimate-like primate and is totally deficient in arboreal adaptations, while *Smilodectes* and *Notharctus* which appeared a few million years later were already advanced tree-climbers.

Arboreal characters can be briefly summarized as follows:

- Mobility of the hands and feet and particularly of the thumb and big toe which are well separated from the other digits and, in some primates, capable of being opposed.
- Replacement of sharp claws by flattened nails, associated with the development of sensitive pads on the tips of the digits.
- A shortening of the snout associated with a reduction in the apparatus and the functions of smell.
- Convergence of the eyes towards the front of the face associated with the development of stereoscopic vision.
- A large brain relative to body size.
- An upright posture which may be confined to the upper part of the body in some but applies throughout in others.

The lemur-like Eocene family the Adapidas (including the genera *Notharctus* and *Smilodectes)* possesses most of these arboreal adaptations: nails had replaced claws and sensory pads were developing on the finger tips, the eyes were converging and the snout was shortening, the brain was relatively large, and the locomotion pattern involved an upright posture of the upper part of the body while in the lower part the hips and knees were acutely flexed.

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When the ape line and human line diverged

This last feature, alone, merits our particular interest because the upright posture is one of the hallmarks we are committed to trace. Later forms such as *Necrolemur*, an early European tarsier-like primate, and *Hemiacodon*, a North American form, show a similar postural pattern.

The next recognizable stage in the fossil record is seen during the geological epoch known as the Oligocene; at present the ancestor-descendant linkages between the Oligocene and Eocene primates have not been proved. Most of our information about the Oligocene primates comes from a region of Egypt called the Fayum, now desert but once covered with dense tropical forest.

Between 25-35 million years ago the Fayum was the home of an extraordinary variety of ape and monkey-like creatures. Some, like *Parapithecus*, were probably destined to become true monkeys; some, like *Aeolopithecus*, to become "half-apes" like the gibbons, and some, like *Aegyptopithecus*, to become true apes like the chimpanzee and the gorilla.

It has even been suggested very tentatively that one of these creatures called *Propliopithecus* represents the earliest known member of the human lineage. Both *Propliopithecus* and *Aegyptopithecus*, of which only teeth or jaws are known, show some of the characters which anticipate the human condition. *Aegyptopithecus*, while possessing some human-like dental characters, also has features which are strongly reminiscent of later apes.

This raises an important point: the relationship of man and apes. Nearly everyone would agree that their relationship in terms of anatomical structure and physiological and biochemical functions is extremely close. The principal issue is how close? When did the ape line and the human line diverge?

There are at least four schools of thought which we can call the "late-late", the "late", the "early" and the "early-early". Personally, I favour the late school but there is something to be said for the early school which would hold that the human lineage dates back to *Propliopithecus*, some 30 million years ago.

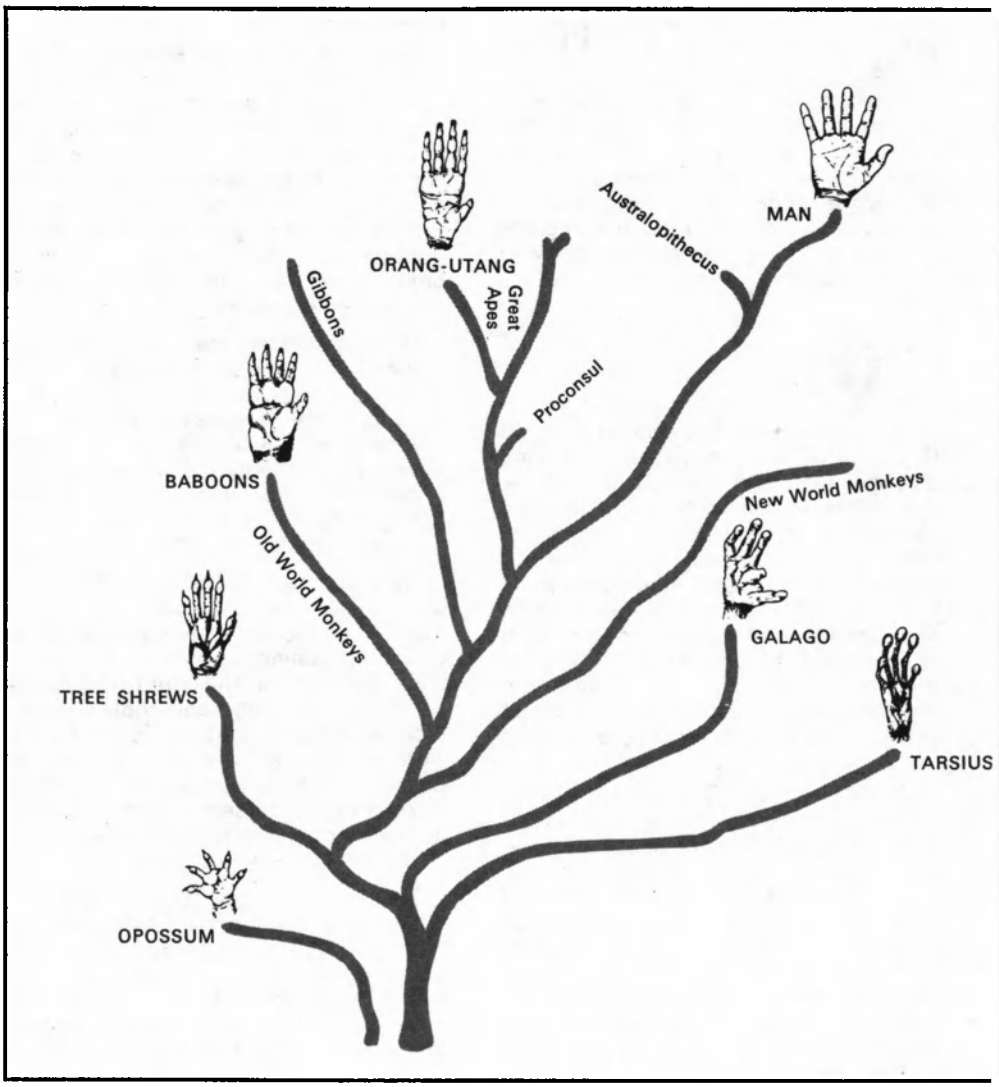
The late school favours the early Miocene species from Kenya, East Africa, called *Proconsul africanus* (or something very like it) as a likely candidate. We know a little bit about the gait, the skull and the teeth of *P. africanus*. The gait was quadrupedal and therefore provides no particular hint of future bipedalism; the hands are rather human-like in proportion but the evidence of an advanced type of precision grip is absent; the opposability index has been estimated at 56. The brain is still rather primitive but was quite large in terms of body-size, and the teeth—like those of *Aegyptopithecus*—are ape-like rather than man-like, but not so completely specialized that one could not envisage an evolutionary reversal to a human-like form.

During Miocene times volcanic activity, rift-valley formation and mountain-building were in full swing. One of two consequences of this orogeny and the coincidental cooling of the earth's surface, which had been steadily proceeding throughout the Tertiary era, was the spread of grasslands at the expense of forests. Grasslands (or savannas) offered new evolutionary opportunities to a variety of mammals, including the expanding population of primates in the rapidly shrinking forest zones.

A few primate stocks, including the ancestors of man and the ancestors of the modern baboons, evidently reacted to the challenge of the changing environment. In this way new horizons were opened up for our remote human ancestors, and for the evolution of the critical hallmarks of mankind.

The earliest human ancestor as we see it at present was a creature called *Ramapithecus* known from north-west India and East Africa. Our material evidence for the potential humanity of *Ramapithecus* is slight and consists only of jaws and teeth but is, nevertheless, very revealing.

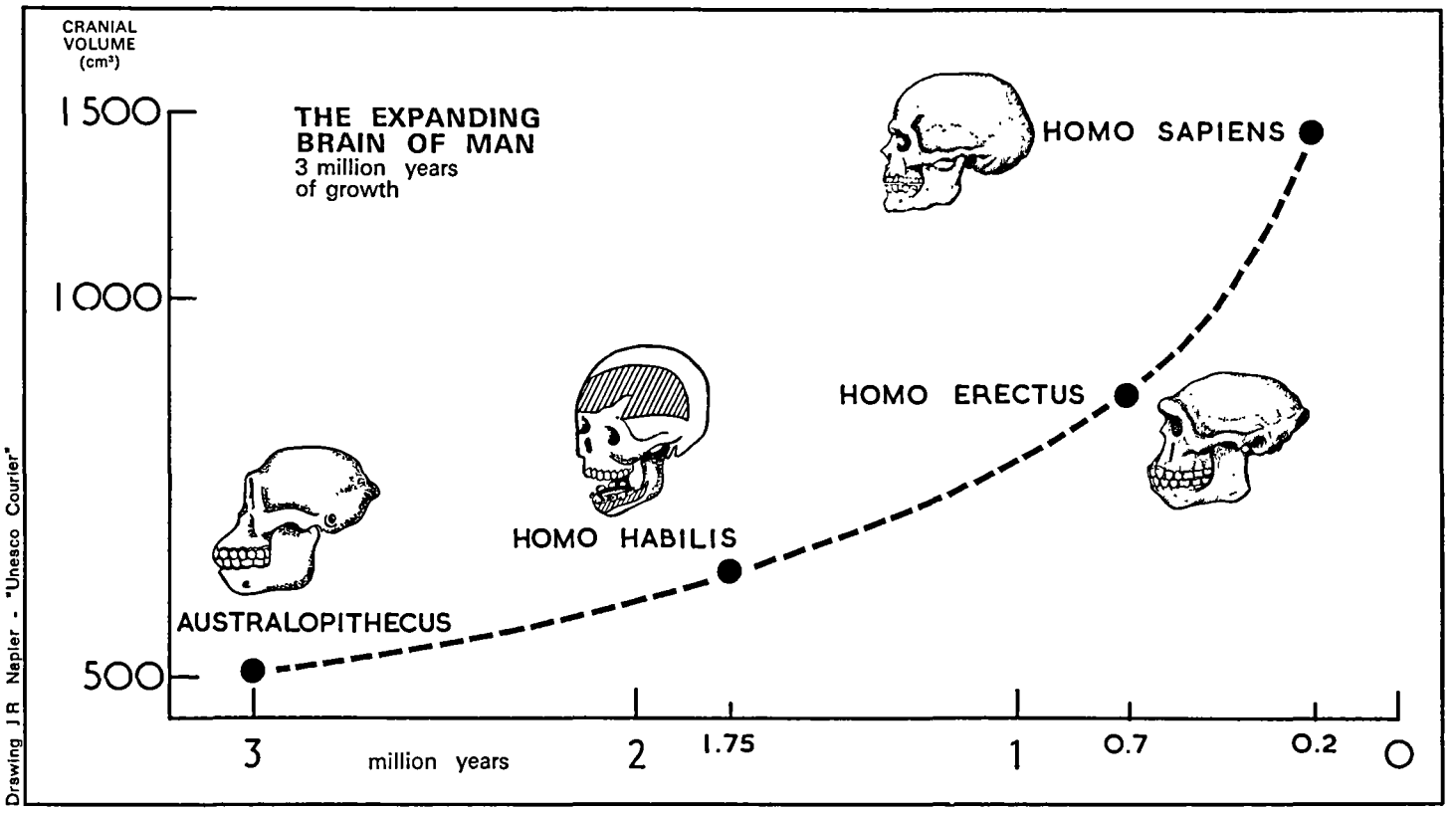
Ramapithecus has a distinctly man-like tooth form lacking all the ape-like characters seen in *Aegyptopithecus zeuxis* and *Proconsul africanus*. The dental arcade is rounded, the canines are small and the molar teeth do not increase in size from front to back as in the apes. *Ramapithecus* lived bet-



Drawing © W. Howells

NATURE'S HANDIWORK

The evolutionary process has provided man with hands of astonishing dexterity, combining considerable strength with delicate precision. This drawing is a combination of two diagrams published in Dr. W. Howells' book "Mankind in the Making", Doubleday and Co. Inc., New York, 1959.



Graph shows how the growth of brain capacity has turned modern man into an "egghead". To make comparison easier the fossil remains of a Homo habilis skull are shown superimposed on the outline of a present day skull.

ween 12-14 million years ago but of course his ancestors may have evolved several million years before this date.

The next recognizable stage in the human lineage started, apparently, at least 4-5 million years ago. There is fragmentary evidence that pre-human creatures belonging to the genus *Australopithecus* existed in two areas of East Africa, called Kanapoi and Lothagam. We pick up the trail of these near-men two million years later in the area of Lake Rudolf, again in South Africa, and in Tanzania at Olduvai Gorge; in all these regions they are most prolific. The early (Lothagam and Kanapoi) australopithecines do not tell us very much, but the later forms in East and South Africa show many of the characteristics of the gait, brain-size and tooth form that we are searching for.

Australopithecines are generally regarded as near-men. Technically, under the curious rules of current anthropology, they do not qualify for the accolade of human beings, but at Olduvai Gorge 1.75 million years ago some of us accept the fact that the zoological genus *Homo* (man) first made his appearance. His way of life appears to have been that of a scavenger, a hunter of small game, and a toolmaker.

Homo habilis, as this early man is called, was a bipedal walker and probably a "strider"; his brain was still small by modern standards but bigger than his predecessors', and his teeth showed a slight advance on the teeth of the australopithecines. His hands were of a human type but lacked the refinements of precision grip possessed by modern man.

Homo habilis was succeeded in the fossil record by *Homo erectus*, known from South-East Asia (Java), Asia (China), Europe (West Germany) and both North and East Africa. Early *Homo erectus* (from Java) had a bigger brain than *Homo habilis (H. habilis*, 656 cc; *H. erectus* 935 cc) and the later manifestations of this species, from Peking for example, showed a maximum brain-size of 1,225 cc.

In spite of this large brain volume, *Homo erectus* possesses a skull of primitive and easily recognizable shape. His gait is assumed to have been both bipedal and striding. The form of his hands is unknown, so the only guide to the extent of his dexterity are the tools that he made. These fall broadly into the class of "power tools", stone artifacts of simple construction designed for relatively crude purposes such as killing and skinning animals, cutting wood and pounding vegetable products. It has been shown by experiment that these could have been constructed and used in the absence of an advanced form of precision grip.

Perhaps it was an increase in brain-size that stimulated the evolutionary improvement of the hand, but perhaps it was the other way about. Anyhow it seems highly probable that the complexity of the brain, the precision capabilities of the hand and the evolution of "precision tools" were closely interlinked.

Exactly where and when *Homo erectus* passed the baton in the human relay-race to *Homo sapiens* is not known. It may have happened in different parts of the world, at different times, and in different ways. There is no saying which geographic population of early men did it first.

With the evolution of *Homo sapiens*, which is dated somewhere between 250,000-400,000 years ago, our railway journey is almost at an end and we are entering the suburbs of the metropolis. Most of us can begin to put on our overcoats and lift our cases down from the rack. The engine-driver has read the signals correctly, the signalman has done his job and our work is virtually over—over for some, but not for all. The complexities of the suburban system are still to be negotiated, and for certain experts this part of the trip is a matter of deep concern.

They are the specialists in the growth of agriculture, of citizenship, of social and political systems, of the spread of populations and the intermingling of genes, processes which are leading us slowly but inexorably towards the eventual unification of mankind in a single biological and cultural entity. Only when the train comes to a final stop at the terminus —at some future date—will these people reach for their overcoats and suitcases and dismount. ■

ANTARCTICA, SIBERIA OR ACROSS THE PACIFIC...

Where did the first Americans come from?

by Juan Comas

WHERE did the first inhabitants of America come from? At what time in history did their immigration to the American continent begin? These are the first questions we must ask ourselves before seeking to determine the biological and cultural traits of the first settlers in America.

I have used the terms "immigration" and "settlers" on purpose, thereby explicitly rejecting the belief commonly held at the end of the last century and in the first decades of the present century, according to which the New World saw man evolve independently from earlier forms as in the Old World, and hence that early forms of man existed in the Americas many hundreds of thousands of years ago.

This is the theory held by the so-called "autochthonists" who based their beliefs on the discovery of bone remains on the American continent attributed—erroneously—to hominids less evolved than *Homo sapiens* and unearthed in geological strata judged to be—also erroneously—much older than has since proved the case.

Going counter to this belief is the fact that only the less evolved primates, that is, lemuroid fossils corresponding to the Eocene period at the beginning of the Tertiary Era (some 55 million years ago) have ever been found in America. As to the present-day living species, the New World comprises only the simpler types of simians, known scientifically as platyrrhines, but there is no trace of the higher types of primates, called catarrhines, which include apes and the anthropoids.

As for the ancestors of *Homo sapiens*, such as the pre-hominids and hominids, they are completely unknown to the Americas though they have been found in Africa, Asia and Europe. All of the prehistoric bone remains found on the American continent indisputably belong to modern man and hence are much much more recent than any of the more primitive forms such as *Homo erectus* or Neanderthal Man discovered elsewhere.

Many suppositions have been advanced over the years (and passionately argued) to explain where the first settlers in America came from. The list includes the Phoenicians, Hebrews, Etruscans, Egyptians, Sumerians and Aryans, but no scientifically valid proof for any of these suppositions has been forthcoming, nor, for that matter, for the existence of the imaginary, fabulous Atlantis as the birthplace of the first Americans.

Certain writers in the 19th century and even in the present century took it for granted that all the Indians of America stemmed from a common biological stock. This gave rise to the common saying that: "all Indians are alike in colour and other features. When you've seen an Indian from one region you have seen them all."

This was based on the idea that all the migrants to the New World were Mongols of Asian origin who had crossed the Bering Straits at different epochs going back no earlier than 20,000 to 25,000 years ago. According to this hypothesis, the physical and cultural differences observed among the Indians of the Americas can be explained in two ways: partly by the different degrees of biological evolution of the migratory groups that crossed north-east Asia in the course of thousands of years; partly by the differing environments of the various regions of America the settlers established themselves in.

Other scientists, however, are of the opinion that from remote antiquity

CONTINUED PAGE 48

Diagram shows some of the animals that lived in America from 40,000 B.C. to 7,000 B.C. Now extinct "giants" such as the mammoth and the camel then roamed the land in great numbers and herds of horses are known to have existed 40,000 years ago. Weapon points used by America's prehistoric hunters to bring down their animal quarry are shown at right. Spearheads have been found still embedded in the fossil remains of some animals. The Stone Age Indian could make a new weapon point in a few minutes—even a neatly polished axe within hours—so he did not always bother to pull out his spearhead for re-use or cut it out when the shaft had broken off.

JUAN COMAS, *born in Spain and now a citizen of Mexico, is internationally known for his work as an anthropologist. He is head of the department of anthropology of the University of Mexico, and editor of the authoritative "Anales de Antropologia", published by the university in Spanish. He was for many years vice-president of the International Union for Anthropological and Ethnological Sciences, and was a member of both committees of experts on racial questions set up by Unesco in 1949 and 1955. (See bibliography inside back cover.)*

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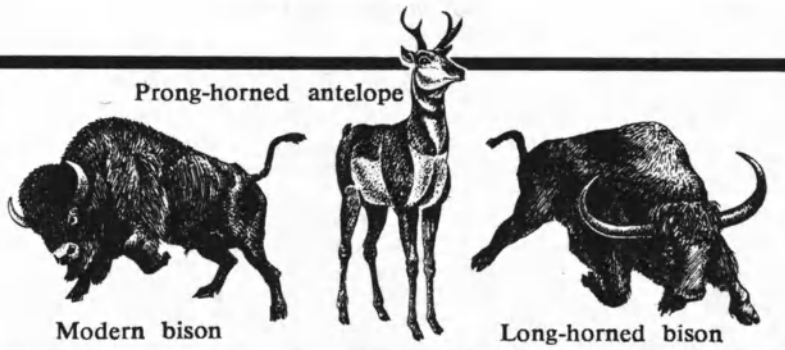
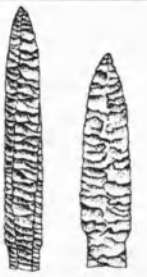
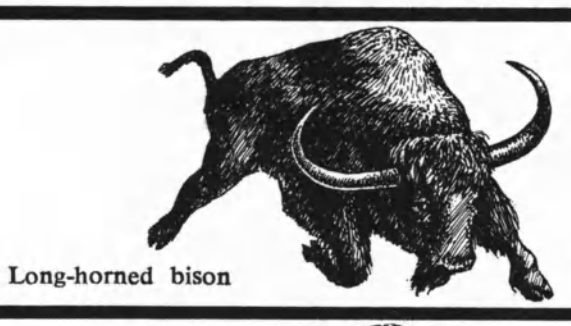
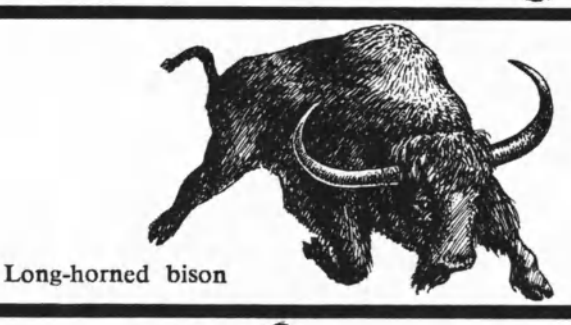
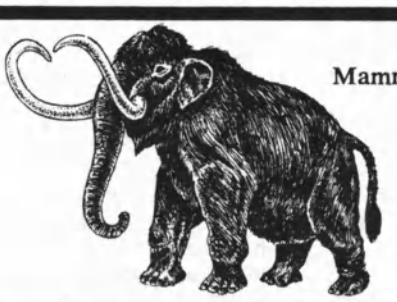
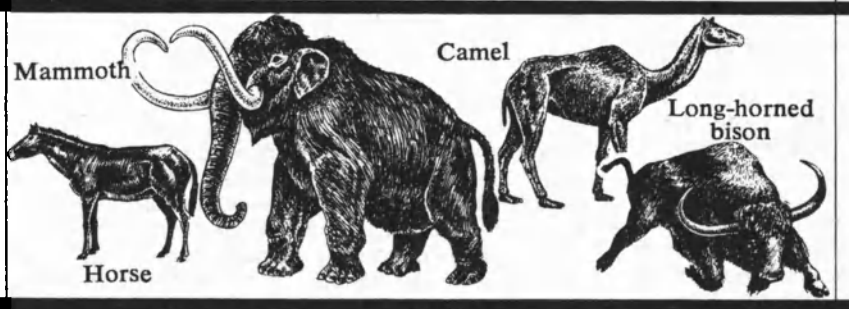
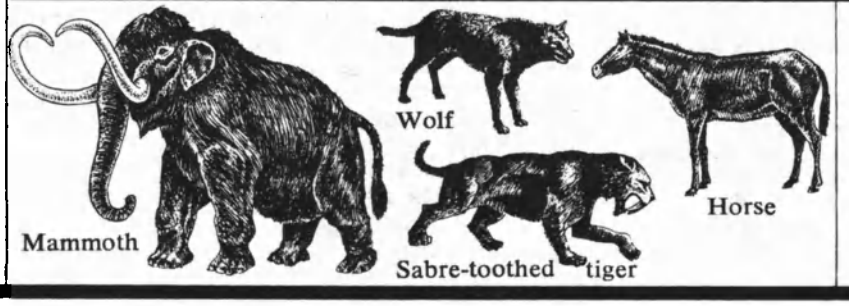
PLANO	9,500 to 7,000		
PLAINVIEW	10,000 to 7,500		
FOLSOM	11,000 to 9,000		
LLANO	15,000 to 11,000		
SANDIA	25,000 (?) to 12,000		
EARLIER PERIODS	38,000 (?) to 20,000 (?)		

Drawing © Editions Le Seuil, Paris, 1970, from "Les Indiens", by Peter Farb

Deep in the heart of Texas 40,000 years ago

there coexisted on American soil human groups of different physical characteristics and of different origins. All the scientists who support this "multi-racial" thesis nonetheless unanimously agree that the Mongoloid element that crossed the Bering Straits from Siberia at different periods of migration by far dominates all other groups.

According to Paul Rivet, former director of the Paris Musée de l'Homme, the populations of pre-Columbian America are the result of migrations to the continent of four racial groups: Mongols and Eskimos via the Bering Straits, Australoids and Malayan-Polynesians across the Pacific. Rivet based his conclusions not only on the findings of physical anthropology by studying data on physical and other characteristics of Indian groups from southern South America and those of Indians from certain areas in Brazil, Baja California and Ecuador, but also on cultural and linguistic analogies with population groups in Oceania.

A. Mendes Corrêa, of Portugal, advanced the theory that an Australo-Tasmanian human element populated America not by sailing across the Pacific but by marching across Antarctica, island-hopping across the string of archipelagos between Tasmania and Tierra del Fuego at the southern tip of South America!

Mendes Corrêa has indeed demonstrated that between 15,000 and 6,000 B.C., Antarctica was free of glacial ice and actually had a temperate climate at the time. Obviously, no archaeological proof exists to confirm this Antarctic migration hypothesis, and it will be extremely difficult, not to say impossible, to uncover any evidence with the permanent ice cap now covering all of the Antarctic continent.

According to Jose Imbelloni of Argentina, one cannot truly understand the racial and cultural history of early America without taking into account the contribution of the peoples of south-east Asia. Imbelloni concludes that seven distinct racial groups migrated to America : Tasmanoids, Australoids, Melanesianoids, proto-Indonesians, Indonesians, Mongoloids and Eskimos. In his works he describes and delineates a total of 11 types of Amerindians.

More recently (1951) Joseph Birdsell of the U.S.A. sharply criticized the contradictory views concerning the population of the Americas put forward by various multi-racial exponents such as G. Taylor, R.B. Dixon, H.S. Gladwin, E.A. Hooton, E.W. Count, F. Weidenreich and J. Imbelloni. He advanced his own hypothesis that America had been settled by a mixture of two racial groups, Mongols and "Amurians" or archaic Caucasoids who had also reached the New World via north-east Asia.

As proof of this dual origin, Birdsell claims to have found "Amurian" traits in contemporary American Indians, among the Cahuillas of the interior of Lower California and among the Yuki and Pomo of the northern Californian coast. But if the Indians of North and South America were indeed the result of the mixture of only the two Mongoloid and Amurian strains, there ought to be a much greater similarity in blood groups than has actually been observed, particularly as regards the A-B-O and M-N groups.

There have been repeated efforts to establish similarities and indeed possible contacts between the "redskins" of the Atlantic seabord of the United States and the prehistoric Caucasoid man of the Cro-Magnon type who peopled western Europe at the beginning of the Upper Palaeolithic or Old Stone Age. Such claims cannot be dismissed since they do contain an element of possibility but no proof of any kind has yet been forthcoming.

FROM the above we can summarize our conclusions concerning the first inhabitants of the American continent as follows:

1) No authochtonous human population ever existed in America.

2) Never was there nor is there now any biologically homogeneous Amerindian type.

3) The overwhelming population migration consisted of Mongoloids.

4) There is still doubt and debate as to what and how many other human types also populated America, the most widely accepted hypotheses being 2 (Birdsell), 4 (Rivet) and 7 (Imbelloni).

The advocates of each of these hypotheses naturally explain the physical and other differences between the various types of Amerindians in different ways, and no definite conclusion can, of course, be reached until more extensive data is obtained. However, the large number of archaeological explorations carried out in recent years in various parts of the Americas has unearthed a rich store of stone implements and other objects as well as, to a lesser extent, fossilized human remains which, with our modern dating techniques including Carbon-14 now permit us to establish with relative certainty when man first appeared in America and a chronological time-table of his presence there.

Thus we now know that man was present in the United States, for example, as early as 38,000 B.C. at a site found at Lewisville, Texas. Other prehistoric sites have been clocked at 27,650 B.C. (Santa Rosa, California); 19,500 B.C. (La Jolla, California); 8,505 B.C. (Gypsum Cave, Nevada); 7,883 B.C. (Plainview Site, Texas); and 6,274 B.C. (Allen Site, Nebraska). In each case we must allow a few hundred years or more plus or minus as is customary for C-14 readings. The people who lived in this area between 40,000 years ago and 8,000 years ago were all hunter-gatherers.

The oldest human settlement in Mexico has been found to be Tlapacoya in Mexico State where a disc-shaped file and an obsidian knife have been unearthed dating back to 20,200 B.C. (plus or minus 2,600 years) and 21,150 B.C. (1,950 years) respectively. Later prehistoric sites are also known, of course, which show that they too belonged to hunter-gatherers.

Here are a few examples of datings from South America (plus or minus years are omitted): crude stone tool industries in Venezuela (14,375 B.C. and 12,275 B.C.); cultural remains in Lagoa Santa, Brazil (8,024 B.C.); pre-ceramic lithic culture in Lauricocha, Peru (7,566 B.C.); Inithuasi Grotto at San Luis, Argentina with a pre-ceramic lithic industry (6,068 B.C.); a cultural complex on the high terraces of the Gallegos river in southern Patagonia dating from between 10,000 and 7,000 B.C.; excavations in Chile (9,380 B.C.) and elsewhere in southern Patagonia (8,760 to 6,700 B.C.).

From the above examples a very interesting observation can be made, namely, that as we proceed southward the datings of the hunting and gathering cultures are less ancient. Is this a confirmation of the thesis that the settlers of America came exclusively by way of the Bering Straits and that South America was therefore peopled many millenia later than North America? I believe it is still too early to say and we must wait for further research and investigations.

IT is generally agreed, for the moment, that the oldest date of 38,000 to 40,000 years ago corresponds to the beginnings of the warming up period of the last Ice Age in North America (known as the Wisconsin glaciation) when it was possible to cross from eastern Siberia to Alaska and thereby reach the more temperate regions of southern North America.

Culturally, the first hunter-gatherers evolved until they became sedentary groups after learning to cultivate plants and domesticate animals. This was a slow and gradual process, but we have evidence of prehistoric sites where hunter-gatherer tribes were simultaneously engaged in the cultivation of squash, chile beans and later, maize.

Photo © H.W. Silvester - Rapho, Paris

CAVE DWELLERS OF THE AMERICAS. Dating by modern scientific methods of recently discovered stone implements and fossil human remains in various parts of the Americas show that man was present in the United States as early as 38,000 B.C., in Mexico by about 20,000 B.C. and as far south as Patagonia between 10,000 and 7,000 B.C. Many finds have been made in caves once occupied by Stone Age man. Photo shows a more recent site, known as the "Mummy Cave" in the grandiose setting of Chelly Canyon in the state of Arizona. Here hundreds of cave dwellings and graves containing mummies have been found showing that it was occupied by man right down to historical times. Ruins at entrance date from later pre-Columbian Indian times.

Such agricultural sites have been found at Tamaulipas, Mexico, dating back to between 7,500 and 5,500 B.C., at Sierra Madre, Mexico (4,500 - 2,500 B.C. and 5,000-3,000 B.C.). In the Tehuaca area of the State of Puebla in Mexico several prehistoric sites have been unearthed offering definite proof of the existence of agriculture between 6,000 and 5,500 B.C.

In New Mexico (USA) agricultural levels have been found at a site known as Bat Cave dating back to about 3,300 B.C. while in the Peruvian Andes agricultural complexes dating between 4,700 and 3,000 B.C. have been found at Huaca Prieta, Nazoa, Paracas, Chilica, and other sites.

The evolution from the hunter-gatherer stage to agriculture occurred in America independently of the same development in the Old World. Research in plant genetics, ecology and ethno-history as well as chronological datings have effectively demonstrated this, thus refuting the thesis that agriculture was introduced into America from Asia.

The initial phases of an agricultural economy are known to have occurred in different parts of America, first with seasonal sedentary settlements and then year-round permanent agricultural sites. Central America and the Peruvian-Bolivian area are at least two of the centres on the continent which originated the cultivation of certain species of plants. Graded terraces and *Chinampas* (incorrectly called "floating gardens") are two typical techniques used here in early intensive agriculture.

From this point we see the beginning of a new process of development, the so-called "high cultures" based on what Gordon Childe has termed the "urban revolution", depending on extensive cultivation of maize, yucca, potato, beans and squash as well as the manufacture of ceramics, the use of polished stone implements and the beginning of the textile industry, etc.

In Meso-America (Mexico, Guatemala, parts of Honduras and El Salvador) the high cultures began around 1,500 B.C. in the highlands. This was the case with the Toltec, the Aztec and Zapotec civilizations which ended with the arrival of the Spaniards in the 16th century. The Olmec, Maya and Totonec civilizations emerged in the lowlands a little later than 1,500 B.C.

In the Peru-Bolivia area, both along the coast (Huaca Prieta, Cupisnique, Paracas, Mochica, Nazoa, Pachacamac, Chuncay and Inca civilizations) and in the Andean uplands (Chavin, Cajamarca, Huaylas, Huilca, Qalassaya, Tiahuanaco and Inca civilizations) the high cultures began to develop about 1,600 B.C. until their decline at the end of the 15th century A.D.

Alongside these great civilizations there also existed much less advanced cultural groups, hampered no doubt by the rigours of their surroundings and habitat. Notable amongst these were the populations living in the great river valleys of the Amazon, Orinoco and Parana as well as their many tributaries.

From the 16th century, with the conquest, colonization and acculturation stemming from the arrival of European immigrants, the original Indian population of America underwent the following three major modifications:

1) The Indians have dwindled to the point of extinction, as in Uruguay, Cuba, Haiti, Dominican Republic and Puerto Rico; or a reduced number are confined to reservations, as in the United States.

2) The Indian population still exists but has little contact with the rest of the country, living within its own self-sufficient economy, virtually untouched by the process of acculturation. Such populations are found in the Amazon and Orinoco river basins, eastern Peru, Bolivia, Ecuador, etc.

3) Large-scale intermingling of races has taken place to the extent that the majority of the inhabitants are biologically and culturally mixed, though small pockets of Indian populations, where less intermingling and acculturation have taken place, continue to exist, as in Mexico, Guatemala, the Andean plateau regions of Ecuador, Peru and Bolivia. ■

Early man and the emergence of races

by Vsevolod P. Yakimov

THE 3,500 million humans on our planet comprise an astonishing conglomeration of peoples. Amid this vast variety, anthropologists distinguish between groups of people having a common origin, living, or having lived, in certain defined regions, and possessing differing characteristic features in their facial structure, skin colour and colour and type of hair.

Scientists call these groups races, but we should remember that there are no strict lines of demarcation between races. All these groups blend imperceptibly into one another with intermediate types possessing various combinations of physical characteristics.

It can readily be seen that distinctions between individual groups do not affect the basic traits that all people have in common—an upright posture, well-developed hands and feet, an intricately structured brain encased in a big skull with a straight, high forehead, absence of a bony eyebrow ridge, the presence of a prominent chin and a common structure of the speech organs. All humans have the same number of chromosomes (46) in the cell nucleus; primates have 48 and the lower simians between 54 and 78.

Thus modern man is biologically uniform in basic features and polymorphous as regards many secondary features, and scientists consider all human beings as belonging to the single species, *Homo sapiens*. The variations found in groups living in different geographical areas reflect only a differentiation within the single species due to a host of biological, social and other factors.

The emergence of the earliest *Homo sapiens* was preceded by the stage of the "oldest" (palaeoanthropus) and the "old" (late palaeoanthropus) people, though it is important to note that late palaeoanthropus co-existed with early *Homo sapiens* in adjoining territories.

The genetic relationship between various groups of palaeoanthropus and *Homo sapiens* is a matter of considerable controversy. The question on which anthropologists are divided is whether all groups of palaeoanthropes can be considered as the ancestors of modern man and whether modern man developed in one or several regions.

In modern anthropology there are two schools of thought on the origins of man and the major races—the polycentric and the monocentric schools.

The founder of the polycentric theory, the American anthropologist Franz Weidenreich, assumes that modern man evolved in several regions, relatively independent of one another, and that people developed at different rates. His theory claims that modern man evolved from the "oldest" and "old" people in each region and that this gave rise to the formation of the major races—Europoid, Negroid, Australoid, Mongoloid, etc.

Anthropologists of this school, such as G. Debetz and V. Alekseev of the U.S.S.R. and Carleton Coon and C. Loring Brace of the U.S.A., point out that representatives of the modern races still possess traits typical of the fossil remains found in territories where these races once lived.

ON the other hand, monocentrists, Henri-Victor Vallios and G. Olivier in France, Francis Howell in the U.S.A., Kenneth Oakley in Britain, Victor Bunak, M. Nesturkh, Y. Roginsky and myself in the U.S.S.R., among others, consider that modern man evolved in a single region. Professor Roginsky believes that *Homo sapiens* emerged in a relatively wide area covering west Asia, parts of central and south Asia, and north-east Africa. Here various groups of palaeoanthropes interbred, enriching the genetic stock and triggering off the development of modern man.

The ancient *Homo sapiens* who evolved there did not possess clearly distinguished traits of any of the modern races. In a certain sense he was "neutral" in racial aspects, and characteristics of the modern races were present in him in the most diverse combinations.

It was only when human groups spread geographically and settled in definite territories that racial types evolved. That is why the races of modern mankind resemble one another so closely. This resemblance is a sign of their common origin, of their emergence in a single region.

The monocentrists, who believe that mankind passed in its evolution through the palaeoanthropus stage, do not, however, maintain that every

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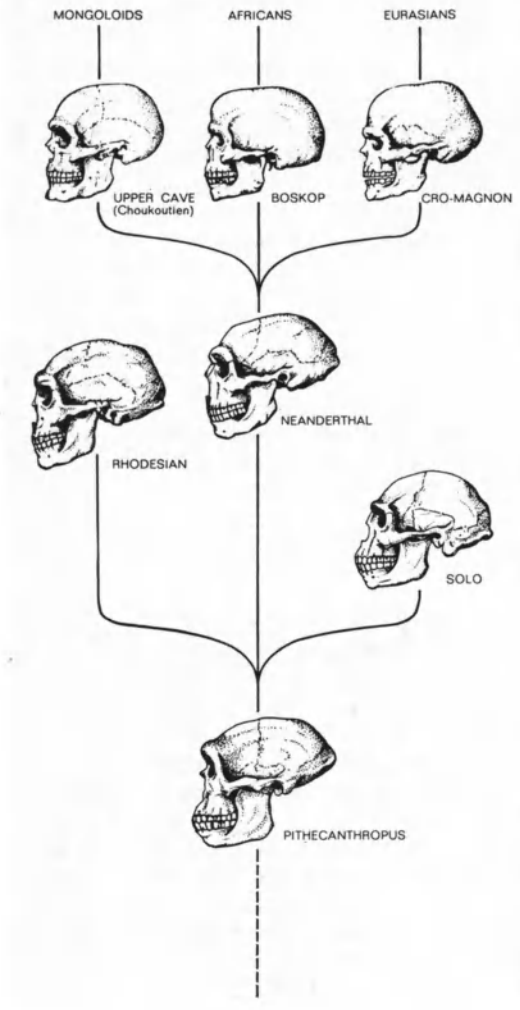

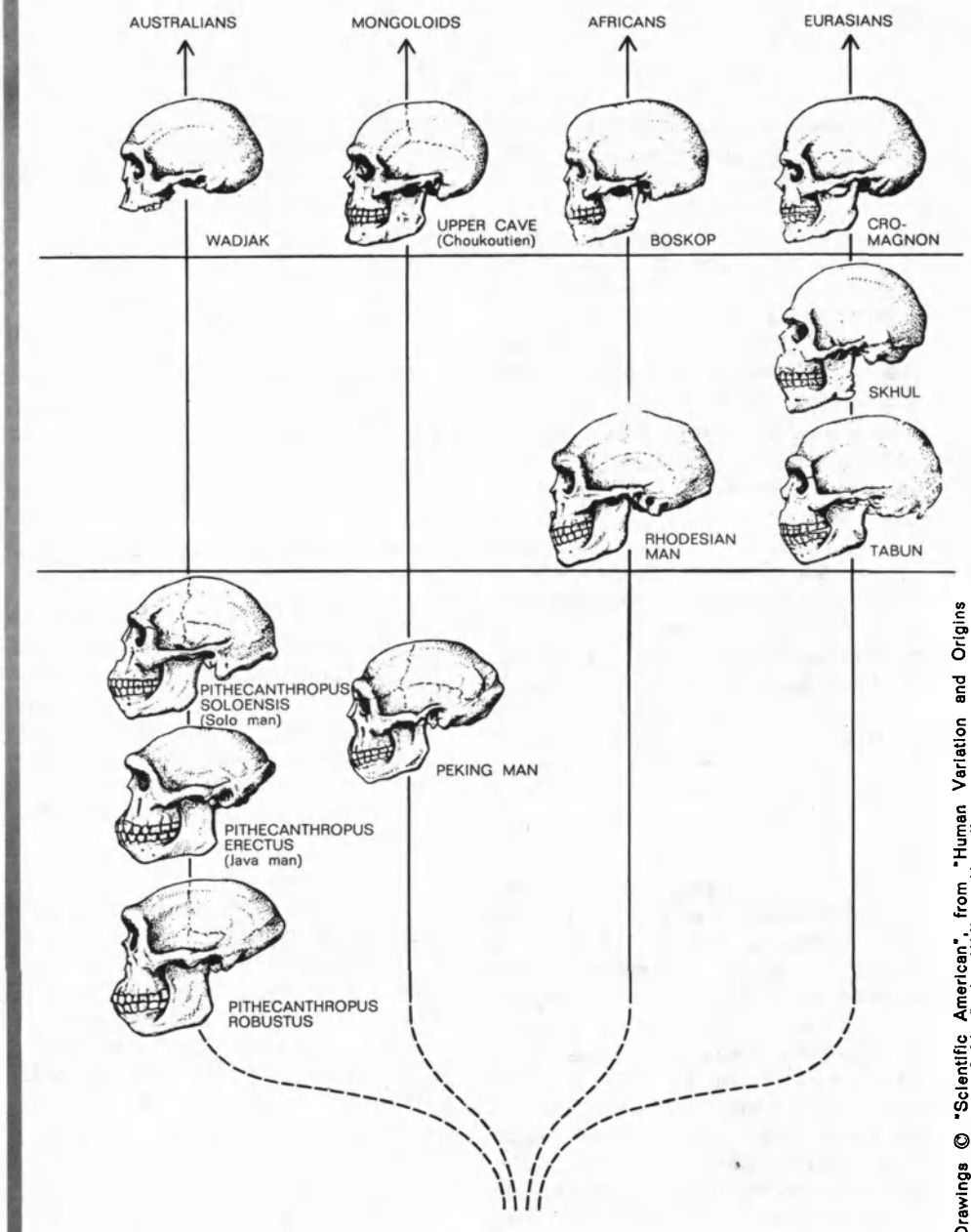

Two major schools exist today regarding the origins of man and different races: the monocentric or unilinear school believes that all races evolved from a single ancestral line (diagram above); opposed to this, the polycentric school sees the modern races of man descending from four ancestral lines (diagram right) which evolved in several regions of the earth.

Drawings © "Scientific American", from "Human Variation and Origins" "The Distribution of Man", by William Howells.

local group of ancient people formed part of the ancestry of modern man. For historical and natural reasons some groups did not participate in the formation of modern man, or participated in that process through subsequent blending with already existing *Homo sapiens*.

Some researchers, including myself, believe the late Neanderthals, the so-called classic Neanderthals, who lived in the Early Würm glacial period some 50,000 to 35,000 years ago, to be one of these groups. They differed greatly from *Homo sapiens* in physical respects; they were short (150 to 166 cm.), massive, with big heads and big, coarse faces, and they also differed in their brain and hand structure.

The late Neanderthals of Europe, however, did not go up an evolutionary blind alley. They too made considerable progress in the development of culture, society and speech. Yet certain of their characteristics, their inordinate physical strength and structural ungainliness, hindered and complicated their transformation into modern man.

This hypothesis is borne out by the palaeoanthropus fossils of the more progressive "sapient" type found in central and west Asia—in the Teshik-Tash caves, in the U.S.S.R. and the Skhul, Tabun and Qafzeh caves, in Israel. It is highly significant that they are older (about 60,000 B.C.) than the "classic" Neanderthals.

Fossils of ancient representatives of *Homo sapiens* displaying some palaeoanthropic traits have been found in the Crimea and the Caucasus, in the Mousterian culture sites generally linked with Neanderthals. This can be taken to indicate that the ancient "sapiens" spread from the area of their origin to the west, where "classic" Neanderthals still existed at that time.

Quite recently the Soviet scientists A. Zubov and V. Alekseev expressed the view that *Homo sapiens* emerged in two centres—north-east Africa and south-west Asia. This is a variant of the polycentrist viewpoint, based mainly on the differences between the specific dental structures of ancient and modern man, and can in a sense be regarded as a compromise between extreme polycentric and monocentric views. Moreover, both centres fall territorially within the fairly extensive area the monocentrists regard as the cradle of *Homo sapiens*.

The most likely hypothesis, there-

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fore, as to who modern man's ancestors were and where and when they emerged seems to be as follows.

Modern man's ancestors were the palaeoanthropes who possessed a set of "sapient" traits and inhabited west and south Asia and north-east Africa. From this one area groups of *Homo sapiens* spread to neighbouring territories. As these *Homo sapiens* populations, morphologically "neutral" in relation to modern races, were migrating, settling and integrating, the modern races formed. *Homo sapiens* probably emerged in the ancient "homeland" some 50,000 to 45,000 years before our time.

This view is confirmed in particular by data furnished by the British anthropologist, Kenneth Oakley. He established that the skeletons from Jebel Qafzeh were 70,000 years old. Morphologically "Qafzeh man" was a transitional form from palaeoanthropus of the "sapient" type to *Homo sapiens*. Radioactive carbon datings fix the age of *Homo sapiens* fossils in Europe at 35,000 to 38,000 B.C. The oldest fossil of modern man, the skull found at Niah, on Kalimantan Island (Indonesia), displaying all the traits of fully formed *Homo sapiens*, is about 39,000 years old.

Many original theories have been advanced concerning the factors responsible for the development of *Homo sapiens*. At the beginning of this century the French archaeologists Gabriel and Adrien de Mortillet considered changes in climate (from humid, sub-tropical to a dry climate) and the change from an arboreal existence (which they believed Neanderthal man to have led) to life on the ground to be the main reasons for his transformation into modern man. Later, H. Weinert (Fed. Rep. of Germany) and V. Gromov (U.S.S.R.) and some other scientists asserted that the colder climate, caused by the advance of the glaciers, had been the main factor in the progressive evolution of the ancestors of *Homo sapiens*.

STILL other scientists believe that the evolution of Neanderthal man into *Homo sapiens* was due largely to the change from in-breeding within small scattered palaeoanthropic groups to breeding between different groups, which thus put an end to the negative consequences of incestuous breeding. Naturally, every one of these factors was important, but it is doubtful whether they alone could have transformed Neanderthal man into *Homo sapiens*.

In 1949 I expressed the view (it was also arrived at independently by Francis Howell of the U.S.A. in 1951) that selection in the severe conditions of the pre-glacial period prevented rather than promoted the evolution of the classic Neanderthals towards *Homo sapiens*. The colder climate did not promote mankind's progressive development and the severe living conditions made the Neanderthal's physique even more rugged.

Refuting the above theory, the polycentrists point out that classic Neanderthals have been found in areas far from the glaciers, notably in Iraq (The Shanidar cave) and in Israel (the Wadi el-Amud site). But they ignore the fact that these were not pure classic Neanderthals since they possessed some "sapient" traits in the structure of the brain-case and the shape of the cerebral hemispheres as shown by moulds of the inner skull surface.

The formation of "sapient" features proceeded more actively on territories free of glaciers. When we discuss "sapient" features, less importance should be attached to morphological traits than to those traits of *Homo sapiens* which substantially distinguish him from his direct predecessor, palaeoanthropus.

Researchers have always been struck by the relatively high development of the culture of *Homo sapiens*, as compared with that of Neanderthal man, by his ornaments and his flair, which his ancestors did not possess, for various forms of graphic art (sculpture, stone and bone carving, polychromic mural painting, etc).

This testifies to a qualitative change in man's thinking, to a growing complexity in the relations between people and hence to a progressive development of social organization and forms of communication—the emergence of speech.

Comparative studies of moulds made of the inner brain-case of palaeoanthropus and *Homo sapiens* fossils show that in the latter the areas of the brain connected with purposeful labour, that is physical activity, speech and the regulation of the individual's social behaviour, underwent considerable changes. Hence we can assume that emerging *Homo sapiens* acquired qualities important to man as a social being. Groups of ancient people who attained such qualities more rapidly found themselves better placed than other socially less organized palaeoanthropic groups.

Professor Roginsky of the U.S.S.R. was one of the first to advance this hypothesis. He drew attention also to the relative stability of the features displayed by man as a species from the moment of his emergence down to our own times, along with the astoundingly rapid advance of techniques and social development.

At the same time the replacement of the Mousterian culture, associated with Neanderthal Man, by the late palaeolithic culture, generally associated with *Homo sapiens*, proceeded against the background of great changes in man's physical type, so important to environmental adaptation. During the transition from palaeoanthropus to man with his present bodily structure, an evolution of the species took place—a transformation of one type of man into another. It can be assumed that, in primeval society, selection, which guided the evolution of the ancients, stimulated their development into *Homo sapiens*.

ONCE *Homo sapiens* had evolved, social tendencies neutralized and weakened the action of the species-forming selective mechanisms, and thus assumed paramount importance. Modern men began to resolve the problems facing them, not so much by adapting themselves to new environmental conditions which had resulted in anatomical and physiological changes in their ancestors, but by relying on and utilizing the fruits of collective labour.

For this reason the physical type of *Homo sapiens* underwent no major changes during many millenia, whereas the range and complexity of his activities developed enormously. Although the morphological changes that took place in *Homo sapiens* during the formation of the major races were partly adaptational, they did not change any of man's traits as a species.

According to this viewpoint, *Homo sapiens* is a supreme stage, in specific qualitative terms, of man's evolution, a stage characterized by a high level of social organization. In this development of man as a social being, speech has played a major role by passing on the experience and wisdom accumulated by many generations and making possible their integration, along with new individual experience, in a collective store of knowledge.

Academician N. Dubinin, the Soviet geneticist, has aptly pointed out that *Homo sapiens* is unique, since, with his advanced social awareness, he has developed, in addition to the hereditary programme possessed by all organisms, a second, non-genetic, non-hereditary programme—"a programme of social heredity" as Dubinin calls it, which makes for man's progress in every new generation. ■

Photo © Marc Riboud - Magnum, Paris

Students at Peking University make a plaster reconstruction of the head of *Sinanthropus* or "Peking Man", who is believed to have lived 600,000 years ago. The original *Sinanthropus* skulls, found at Choukoutien, China, were lost whilst being transferred from Peking during the Second World War, leaving only a set of plaster casts and photographs made in the 1930s (see p. 55).

The puzzle of Peking man

by Pierre Leroy

THE discovery near Peking, in December 1928, of the very early fossil remains of a man, *Sinanthropus*, or Peking Man as he has been named, was an event of primary importance in the history of the origins of man.

As early as 1914, the Jesuit priest and natural historian, Father Emile Licent, had begun exploring the Basin of the Yellow River in the north of China. There he had come across some important layers of mammal fossils—"dragons' teeth" as the Chinese called them. Himself no palaeontologist, he sent sample fossils to Marcellin Boule, Director of the Institute of Human Palaeontology in Paris, who entrusted the task of examining and cataloguing them to one of his pupils, Father Teilhard de Chardin. Finally, in 1923, it was decided that Teilhard should go to China to examine the fossil layers on the spot.

A French palaeontological expedition was organized during which Licent and Teilhard explored an area on the edge of the Ordos desert, to the north of the Great Wall, where they discovered important layers of mammal fossils and some chipped stones which on examination proved to be extremely ancient. They concluded that prehistoric man had once inhabited these regions, but no human remains were found which could help to identify the craftsmen responsible for fashioning these stone implements.

In 1918, the Swedish geologist J. Gunnar Andersson, founder of the Museum of Oriental Antiquities at Stockholm, was invited out to China to explore certain regions in northern China for mineral deposits.

Johann Gunnar Andersson had studied at Uppsala University which, in 1710, had become the headquarters of

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FATHER PIERRE LEROY, S.J., *of the French National Centre for Scientific Research, in Paris, was formerly director of the Museum of Natural History, at Tientsin and of the Institute of Geobiology, in Peking. He was a friend and collaborator of Father Teilhard de Chardin, and is the author of "Dans le Sillage des Sinanthropes" ("In the Track of Sinanthropus"), Fayard, Paris (1971), which presents unpublished letter between Teilhard de Chardin and J. Gunnar Andersson, who first investigated the Choukoutien site in China where the remains of Peking Man were discovered.*

Photos © Teilhard de Chardin Foundation, Paris

THE QUARRY OF CHOUKOUTIEN

PEKING MAN *(Continued)*

the Swedish Royal Academy of Sciences. Men such as Berzelins and Linnaeus had made the Academy one of the most renowned of its kind in Europe. Fresh from university, Andersson had taken part in Otto Nordenskjold's dramatic expedition to the South Pole in 1901. After their ship, "The Antarctic", had been crushed by the ice, the members of the expedition were taken aboard the Argentine warship "Uruguay" and returned to Sweden in 1903. Andersson became a professor of Geology and, at the age of 32, President of the Swedish Geological Society.

Andersson began prospecting some forty miles to the west of Peking. It was a region of bare hills whose limestone bedrock had opened here and there and accumulated pockets of sun-baked clay, the "red earth" of the Chinese geologists. Here he discovered a vast deposit of mammal fossils in a perfect state of preservation. So rich was the find that he decided to postpone its exploration until later, and in 1920 he returned to the site accompanied by Dr. W.D. Matthew, a palaeontologist from the New York Museum of Natural History, and Dr. Otto Zdansky, of the University of Uppsala.

In the course of the excavations, Zdansky found, among the rubble of bones, two teeth which he was unable to identify; had they come from a monkey or from a man? Four years were to pass before this puzzle was resolved. In October 1926, to the general surprise, Andersson took a definite stand—the teeth found by Zdansky, he declared, were human, and a hominid had probably lived at the site of the find.

Then, two years later, Dr. Birger Bohlin of Uppsala University, discovered a perfectly preserved lower molar in the same quarry. There was no room left for doubt, it was a human tooth, and the quarry in which it was found was to become world famous—the quarry of Choukoutien.

IT was now certain that prehistoric man had inhabited the vast territory of Asia, from south of the river Yenisei to Peking. But where were other remains of these creatures to be found?

The spot to be explored was selected on the basis of Andersson's intuition and the discoveries of his colleagues Zdansky and Bohlin. Since Licent and Teilhard had found no traces of human skeletons in the Ordos desert, the search was concentrated on Choukoutien. With the backing of the Rockefeller Institute at Peking and the Geological Survey of China, a team of Americans, Canadians, Chinese, Frenchmen and Swedes set to work.

The enormous mass of earth of the Choukoutien hill was systematically divided up into sections of two metres square. Each cubic metre of earth dug up was carefully sieved so that nothing would be missed.

Dr Pei Wen-chung, formerly a pupil of the Abbé Breuil in Paris, was in charge of the excavations. Father Teilhard, of the Geological Survey of China, was responsible for the stratigraphic study of the terrain.

The internationally famous prehistorian, Abbé Breuil, was also to play an important role. He had previously studied specimens from the Ordos desert and had found traces of ancient palaeolithic workmanship quite distinct from that known in Europe. He was, therefore, conversant with Chinese prehistoric tools and his opinions would be of the greatest value if other stone tools were found.

In December 1929, the dome of a skull—whether of a man or a monkey was not known—was found lying in the sand under a limestone overhang. It was connected, perhaps rather prematurely, with the human molar found earlier by Bohlin. Were its discoverers right to dub it *Sinanthropus* or Peking Man, or were they led, by their desire to produce a startling discovery, to take their dream for reality? At all events, monkey or man, the problem of *Sinanthropus* had now been posed. How was it to be resolved? At that time there was no

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Photo © Teilhard de Chardin Foundation, Paris

Far left, the north side of the Choukoutien quarry, near Peking, where the first *Sinanthropus* skull was found by Dr. Pei Wen-chung in 1929. Far right, a Sinanthropus skull seen from above. During a decade, 14 skulls, 14 lower jaws and nearly 150 teeth—parts of 45 individuals—were found at Choukoutien. Above, Professor J. Gunnar Andersson, the Swedish geologist, who first explored the Choukoutien site. Above left, Father Teilhard de Chardin in 1931, the year he identified fragments of quartz found near the skulls as tools made by *Sinanthropus*.

means of settling the question, the skull was so primitive and incomplete that there was no way of deciding its real nature.

Two criteria, tools and fire, enable anthropologists to decide whether they are dealing with the remains of animals or men. Tools alone are not enough, nor is the ability to fashion them absolute proof of human presence. In fact, under certain circumstances animals are capable of making tools. However, they lack the quality of foresight. Once a tool has been used for its immediate purpose, it is abandoned, rather in the way that a young child may throw its spoon away after eating its soup, not thinking that it will be needed again in a few hours time.

Man is not only a craftsman; his intelligence enables him to make abstractions. He makes tools that will last and this power of abstraction enables him, unlike the animals, to make and keep fire. When, therefore, an anthropologist finds durable tools and traces of fire beside fossil remains that could be either of monkeys or of men, he knows without doubt that they must be the remains of men.

One day, Easter Monday in 1931, I had to go with Father Teilhard from Tientsin to Peking. Teilhard had been away from China for several months and he wanted to have a look at the material from Choukoutien that had been brought to the Cenozoic Laboratory. This was the laboratory in which studies were made of the geology and palaeontology of the period from the Tertiary to the present day.

At the laboratory we met Pei Wenchung with whom we had a long discussion. We were on the point of leaving, when Teilhard asked him point-blank, "Hasn't anything really new been found at Choukoutien?" "No", replied Pei, "we are still turning up lots of remains of stag, tiger, hyena and all kinds of small mammals". Then, as an afterthought he added, "Oh yes, I found this." From the drawer of his desk he took out a few fragments of

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The bone of friendly contention between Father Teilhard de Chardin and Abbé Breuil

quartz which he handed to Teilhard. Teilhard did not hesitate for an instant. At first glance he had seen that these quartz fragments bore signs of deliberate shaping. "This quartz has been worked", he said. Pei's delight knew no bounds. "So these stone fragments found near skulls must therefore be Sinanthropus' tools?" "There is no doubt about it", replied Teilhard. "So Sinanthropus was a man?" "That is my opinion", answered Teilhard.

Teilhard was even more sure of his appraisal since, during his trip to Paris in the winter of 1930, he had visited Abbé Breuil at the Institute of Human Palaeontology and had placed on his desk a small stag's antler on which there was a protuberance. "I shan't tell you where it came from", he told the Abbé, "but what do you make of this object?"

"It was heated shortly after the animal was killed", replied the Abbé, "and it is an implement fashioned by man by hammering the remains of the animal's forehead with a stone; the marks of the stone's impact can be seen on the stem". "But it comes from Choukoutien", replied Teilhard. "I don't care where it came from", replied Breuil, "my conclusion remains the same".

The quartz fragments found by Pei seemed, therefore, to confirm the great prehistorian's opinion. It was immediately decided to send some quartz samples to Breuil in Paris so that he could give his opinion on this vitally important matter.

Without waiting for the Abbé's reply, Teilhard left for Kalgan where he was to rejoin the Citroen motorized scientific expedition which was about to set out for central Asia.

Meanwhile, at the invitation of the Rockefeller Foundation, Abbé Breuil went to Peking, towards the end of 1931. He wanted to examine the Choukoutien site for himself. He did not support the view held by the anatomist, Davidson Black, his former pupil Pei Chen-wung, and his friend Teilhard, and his preliminary assessment was that Sinanthropus was not a man. He thought that he was more likely to be some kind of game on which early man had fed, throwing his bones, along with tools and implements made from stags' antlers, into the Choukoutien quarry. Examination of the quartz fragments showed plainly that they were deliberately fashioned, clearly recognizable tools. Yet there was nothing to support the conclusion that they were the work of *Sinanthropus*.

This was how things stood when Teilhard returned to Peking after a long and wearisome journey across Asia. He immediately took up his work at the Cenozoic Laboratory. Informed by friends of Breuil's doubts, he re-examined all the samples brought back from Choukoutien, comparing them with the *Sinanthropus* remains beside which traces of fire had now been found in the form of a layer of cinders twelve centimetres thick.

Why did Breuil have such strong reserves, and how had he come to think up the improbable theory of the hunter and his game? The reason was that he could see no possible chronological link between the remains of *Sinanthropus* and the perfection of the stone and bone tools he was supposed to have used.

Teilhard was not a man to allow himself to be influenced only by "points of view". He wanted to base his judgement on concrete evidence, and he communicated his own observations to Breuil. After several letters had been exchanged between the two men, Teilhard was unable to convince Breuil and Breuil failed to shake Teilhard's convictions.

SPEAKING about Teilhard, Breuil wrote, "To my great regret he continues to stick to his original standpoint. While Teilhard is a wonderfully good observer of a geological site and an excellent palaeontologist, he was not trained in technical prehistoric studies and the industrial aspects are beyond him."

The point at issue between the two men was that, for Teilhard, the quartz tools found were the work of *Sinanthropus*, while for Breuil, the fact that tools made of bone were also found made this hypothesis seem extremely doubtful.

The more value Teilhard placed on the stone industry as indicative of the capabilities of *Sinanthropus*, the less sure he was of the specific nature of the bone industry. In a letter dated June 17, 1932 to his friend George Barbour he wrote, "A study on the stone industry of Choukoutien will appear in the next Bulletin (of the China Geological Survey). It puts forward a more cautious view than that of Breuil. I don't believe that a systematic bone industry existed at Choukoutien."

A few months earlier (March 20, 1932) he had expressed the same opinion in a letter to J.G. Andersson:

Concerning Choukoutien, you have received Pei's paper (and possibly Breuil's too) on the newly discovered industry. Since these two papers were published we have collected or uncrated a large number of new samples including a large series of chipped boulders. I am sorry not to be in full accord with my dear friend Breuil. My present feeling is as follows:

1) The stones are certainly artifacts.

2) But, even in the case of the finest specimens in quartz-crystal, the industry looks very primitive. I have been unable to recognize any true "pointe", for instance, nothing anywhere near comparable with the Mousterian points in quartz-crystal found in France.

3) The bone and antler industry seems to me to be more than questionable. I think that Breuil has been deceived by appearances which occur in any bone deposit. Logically he is led to recognize a similar industry in the Nihowan Saumerian beds, a supposition which, so far, cannot be admitted.

I hate this disagreement with Breuil, since I like him awfully and since I am partly responsible for his coming to Peking. But what can I do?

The most critical point is to prove that, without any doubt, the toolmaker was Sinanthropus *himself. But the fact that the jaws and a piece of skull were found together with the tools seems as convincing as possible.*

I am preparing with Pei a new paper on this question. What a pity you cannot come here for at least a few weeks. We need you!

Good luck in your work.

Teilhard de Chardin.

Teilhard and Davidson Black were on their way back from the 1933 International Geological Congress of Washington when a cable reached them from Peking announcing a discovery which could either decisively clarify or further complicate the situation at Choukoutien.

At the very top of the hill of Choukoutien, where the site had been broken up by previous excavations, a trench had been dug and a shaft sunk, at Teilhard's request, to give sideways access to the *Sinanthropus* layer at the bottom left of the excavation ditch.

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Cartoon Al Ross © Saturday Review, New York

"He said his first word today, 'pterodactyl'"

Man, the first walkie-talkie

by Victor Bunak

SCIENTISTS have long speculated about the origins of speech, and a great many theories have been advanced.

One of the earliest, already current in Ancient Greece, held that the first words were onomatopoeias—imitations of the sounds prehistoric man associated with his various activities. Another maintained that words developed from inarticulate cries of fear, alarm, delight and so on. According to a fairly recent theory, it was the combination of gestures and vocal noises used to indicate a particular action that led to the emergence of speech.

But none of these theories explains how shouts or onomatopoeias could turn into articulate syllables and words, or what factors determined the development of mental activity along with the faculty of speech so closely connected with it. For it is man's ability to speak that above all distinguishes him from the animal.

Modern science places the beginning of human evolution in the early Quaternary period, some 1.8 million years ago, when a branch of biped primates appeared. These hominids, man's earliest ancestors, lived in the open plains. They were omnivorous, eating fruit, green shoots, roots, birds' eggs, grubs and so on.

Since they were ill-equipped by nature for life in the open plains, they learned to use objects as weapons to defend themselves and as tools to obtain food: rocks to fling at their enemies or prey, bone fragments to clean carcasses, sticks and shells to dig up edible roots. These implements became essential accessories to daily life, multiplying the strength of the hands, extending their reach and replacing the long, sharp claws of beasts.

Animal behaviour is guided by instincts—by a chain of automatically connected actions that never varies. Actions based on choice and the experience of much trial and error are extremely rare.

The chimpanzee, for instance, can use a stick to reach a coveted bit of food. If he is given two short sticks, he will usually amuse himself with them rather than try to use them to reach the food. If he does manage to join them together to attain the food, he will have had to make so many exhausting attempts that the result has no practical significance. This is because the two percepts "action with the stick" and "making the stick longer" exist in his mind quite independently. It is difficult for him to connect them or to substitute one for the other.

The use of implements, not accidentally as with animals, but systematically as in the case of man, became

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VICTOR BUNAK, *of the Institute for Ethnography of the U.S.S.R. Academy of Sciences, is one of the world's leading authorities on the early development of speech. He has written many studies on race, genetics, the theory of the genesis of speech, etc., which have been widely published in the world press. Dr. Bunak is a member of the International Anthropological Association, the International Society of the Biology of Man and of many other anthropological societies.*

successful only when the choice and treatment of materials began to correspond to a preconceived aim, in other words, when an association was established between a chain of actions.

Man finally left the animal world when he was at last able to reproduce in his mind coherent images of different objects and actions, to distinguish between them and to combine some with others. This enabled man to form percepts about the common properties of classes of objects. The mental images of these linked percepts are what we call concepts, and the capacity to form concepts was the first main feature distinguishing *Homo sapiens* from the earlier hominids.

The next stage in man's evolution was the ability to combine and diversify these concepts, a process that represents a considerable development of the intellectual faculty. Concepts form the bricks of man's mental activity, and even the simplest among them differ substantially from the "concrete percepts" to which the mental activity of animals is limited.

The combination of percepts in a single mental operation or concept becomes possible because of its association with vocal stimulations. The link-up between the various percepts takes place in areas of the cerebral cortex that are stimulated by impulses coming from the vocal organs as well as those coming notably from the auditory organs. The sound of the voice and the corresponding movements in the mouth and throat become, as it were, symbols of concepts, a different set of vocal movements being associated with each one.

The vocal organs can produce a great many sounds, but in each language only some 30, known as phonemes, are used (sounds with a distinctive and differentiating function). There are, however, hundreds of phoneme-combinations or syllables, and many thousands of syllable combinations. Even so, the resulting vocal sounds do not become elements of speech until a specific semantic content or meaning becomes attached to them, just as new concepts are not assimilated until they have been given specific vocal expression.

In the early periods of human evolution, before definite speech systems or languages existed, concepts and words were formed simultaneously. This is a dual process which consists of combining mental percepts and vocal movements. When a man thinks, even if he does not pronounce words aloud, his speech organs make rudimentary movements,

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For some 200 years many people accepted without question the idea that the world was created in 4004 B.C., a date carefully worked out in the 17th century by James Ussher, Archbishop of Armagh, on the basis of the ages of Adam and his descendants as recorded in the Old Testament. Although Archbishop Ussher was a great scholar, an expert in Semitic languages and the author of several important studies on ecclesiastical history, his name is today chiefly remembered by many people for the precise date he unfortunately fixed for the Creation, before the birth of the science of palaeontology.

Old fossils and antediluvian theories

by Louis S. B. Leakey
and Vanne Morris Goodall

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PREHISTORY is a comparatively new branch of science but the records of man's preoccupation with the riddles of his origins go back to the dawn of history. In his early search for the truth man drew upon the riches of his imagination, and strange stories, which were invented to explain the mystery of creation, can be found in the myths and legends of many peoples.

As the centuries passed, however, man began to look for a rational explanation of the mystery of life through the study of nature. This led ultimately, as we shall see, to a bitter conflict between the Church and the pioneers of the science of prehistory, which began in the eighteenth century and was brought to a climax in 1859 by the publication of Darwin's *Origin of Species*.

The crude stone cutting tools which were made by our very early ancestors are now accepted as the clues from which we learn about their cultural life. For many thousands of years, however, these implements, fashioned from flint, chert, obsidian or other types of stone, lay scattered over the face of the earth and were regarded as mere "curiosities of nature". Some Greek philosophers believed that these had been launched by Zeus and called them "thunderbolts", and local superstition in many countries invested them with magical powers.

It was not until the latter part of the sixteenth century that Michael Mercati, physician to Pope Clement VIII, realized the true significance of these so-called "thunderbolts". "Most men", he wrote, "believe that *ceraunia* (thunderbolts) are produced by lightning. Those who study history consider that they have been broken off from very hard flints by a violent blow in the days before iron was employed for the follies of war."

Towards the close of the seventeenth century, a London apothecary, John Conyers, who was described by his friend John Bagford as a man "who made it his chief business to collect such Antiquities as were daily found in and about London", discovered "the Body of an Elephant". Not far away he came upon a pear-shaped stone. The two friends must have examined and discussed this stone on many occasions.

In Bagford's opinion, which must have been met with a good deal of scepticism at the time, it represented "a British weapon made of a Flint Lance like unto the Head of a Spear", which had been used in the days before Britons knew the use of brass or iron. Bagford suggested, therefore, that the elephant was one of the many which had been brought to England during the Roman occupation of Great Britain, and had possibly been slain with the stone weapon discovered by his friend Conyers.

It was nearly a century before John Frere made the next correctly interpreted discovery of man-made "stone tools". These stones described by Frere as "spear-heads", were found in the brick-earths in an ancient valley at Hoxne in Suffolk, associated with the bones of extinct animals.

Laying aside the preconceived ideas of his generation, Frere had the courage to announce what he believed to be the true significance of his discovery. He not only recognized the human origin of the tools, but suggested that they belonged to a very remote geological period, an idea which was incompatible with the persistent and widespread belief in a universal flood in Noah's time.

This brilliant interpretation, however, was ignored by contemporary scientific opinion. It was not until 1859, when the brick-earths of Hoxne were revisited, by the geologist Sir John Evans and by Sir Joseph Prestwich, that Frere's interpretations were verified and his place as one of the pioneers of prehistory was established for all time.

It was not long before another vitally important step was taken towards the unveiling of man's origins, when the true status of fossils (which had puzzled generations of men) was finally established. Fossils are now known to be the remains of plants, shells and bones which have been preserved by natural means in the

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'UNVEILING MAN'S ORIGINS'

Most of the major facts now known about man's evolution have been uncovered during the past century and a half by a comparatively new branch of science: prehistory. The growth of this science and its revelations are described in "Unveiling Man's Origins" by L.S.B. Leakey and Madame Vanne Morris Goodall, an informative book published by the Schenkman Publishing Company, Cambridge, Mass., in 1969, and in 1970 by Methuen, London. In this article we present, by kind permission of the publisher, extracts from the first part of the book, entitled "The Background", and dealing with the prelude to the science of prehistory up until 1859 when Charles Darwin published his book on the origin of species.

The date of Creation: 4004 B.C.

earth's crust, and altered in constitution according to the influences to which they have been subjected. They are of vital importance to the prehistorian for they supply the clues which he needs for the reconstruction of the long procession of diverse creatures which have lived on our planet.

The advanced thinkers of the eighteenth century came to believe that fossils were of organic origin. The next step towards a better understanding of their true value was to find out when the fossilized creatures they represented had lived. It was only natural, in an age which was deeply influenced by religious doctrines, that enlightenment should be sought in the Old Testament account of the creation.

An answer which was acceptable to a very large number of scientists was found in the story of "The Flood"; this suggested that all creatures, except those saved by Noah at God's command, had perished under the waters of a "universal deluge".

Clearly, then, it seemed highly reasonable to accept the idea that fossils were the remains of those creatures which had been drowned in the Flood and buried under the debris which covered the earth when the waters went down. This became known as the "Diluvial theory" and was strongly supported by the Church.

But there were a great many free-thinkers who believed that this philosophy was contradicted by the evidence of geology. Groups of fossilized animals, each differing from the others, had been observed in successive geological strata, indicating clearly that they had lived at different geological periods of time. If this was so, then they could not all have been drowned in one and the same great flood.

In order to accommodate the new data, the famous French palaeontologist Baron George Cuvier suggested that there had been a succession of catastrophes, each followed by an era of calm during which the earth had been restocked. He was careful, however, to fit this new philosophy into the accepted biblical chronology.

God's first creation, he suggested, had consisted mainly of marine creatures, his second of reptiles and his third chiefly of mammals. These were destroyed in turn and a fourth creation, as described in the Old Testament, was ultimately swept away by "The Flood", with the exception of the inmates of the ark.

Launched by a man of such reputation as Cuvier, the new "Catastrophic theory" gained immediate support; but a handful of advanced and courageous thinkers began to suspect that the duration of geological time had been grossly under-estimated.

At this time the Church was still blindly supporting the conclusion proposed by Archbishop James Ussher in 1654, that the world had been created in 4004 B.C. He had arrived at this estimate by computing first the ages of Adam and his descendants, as recorded in the Old Testament, and then by adding a number of years deduced from a study of Hebrew history.

Engraving from "Museum Diluvianum", Zurich, 1716

Dinosaur eggs and mammoth bone huts

For centuries before the notion of evolution became generally accepted, men refused to believe in the existence of fossils dating back hundreds of thousands, even millions of years, and all kinds of theories were put forward to explain the strange objects that were constantly being disinterred. One popular theory was that they were the remains of creatures that had perished in The Flood, and in 1716 the Swiss doctor Johann Scheuchzer, seen in engraving left with a collection of fossils, even published a book entitled "Museum Diluvianum". Many years of patient research were required before the idea was accepted that these objects could be the fossilized remains of creatures such as the carnivorous Gorgosaurus (top right) who inhabited the earth some 75 million years ago. The amazing Dinosaur egg, bottom right, was one of a huge quantity of eggs found a few years ago on a tract of land at Roques Hautes, in southern France, by the curator of the Museum of Natural History of Aix-en-Provence. Below, a dwelling built in prehistoric times entirely from Mammoth bones, discovered in 1966 at Miejiritch in the Ukraine, U.S.S.R. The bones of 95 Mammoths were used in the construction of this dwelling which covers an area of 23 square metres.

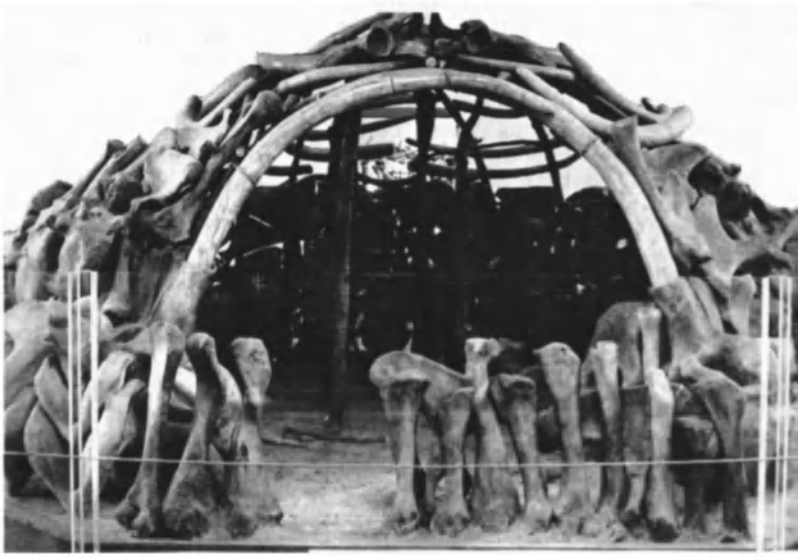


Photo © APN, Kiev, Ukraine

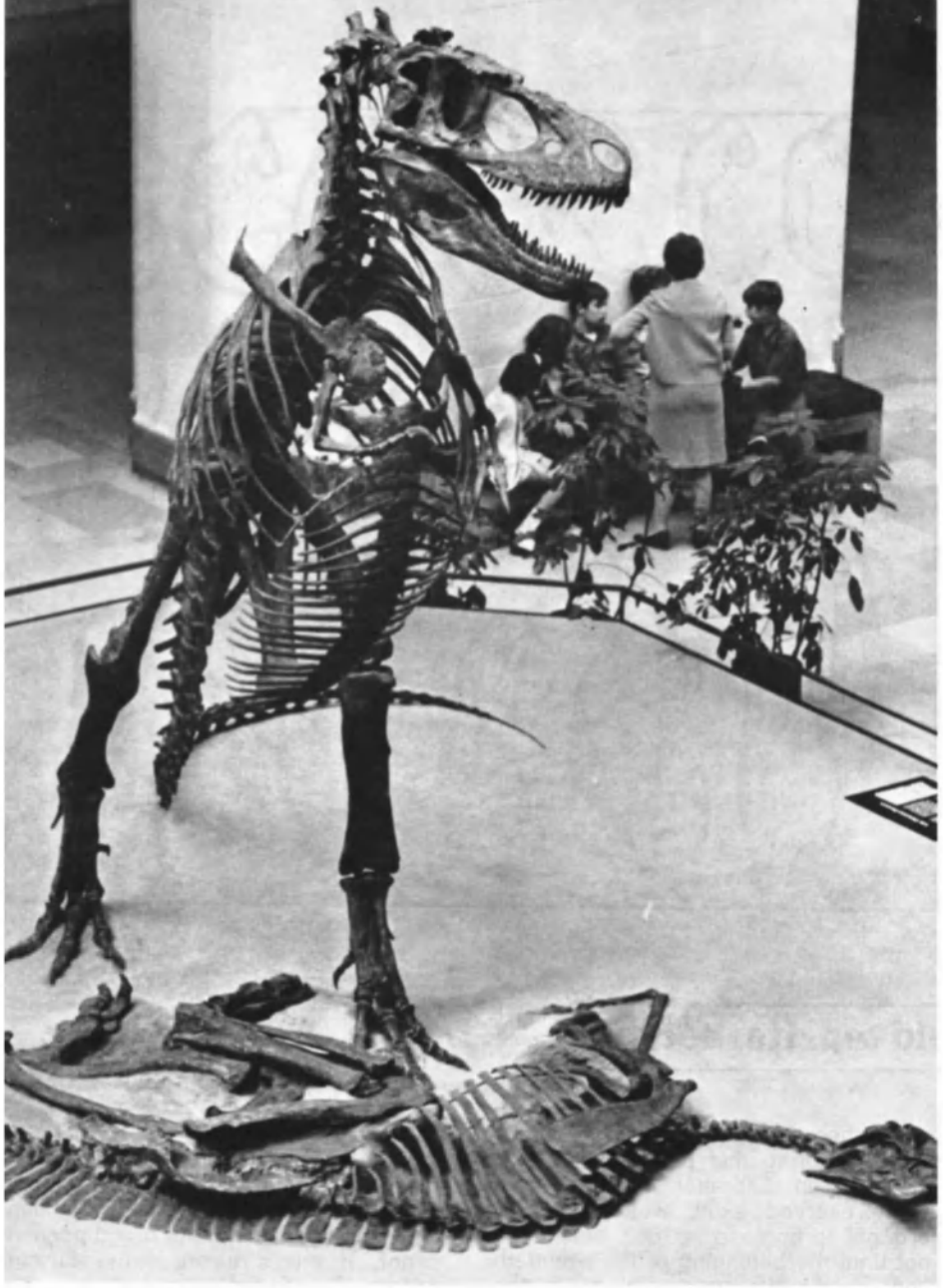


Photo © Field Museum of Natural History, Chicago

Photo © Rapho, Paris

Cuvier could not possibly fit three additional creations into this time scale. He therefore adopted the proposals of Comte Georges de Buffon, a great French geologist, and pushed the creation of the world back by 80,000 years.

The early part of the nineteenth century was remarkable for the intense interest which scientists in Europe, England and America began to take in cave exploration. Reports circulating in 1822 claimed that the caves in southern Germany had yielded the remains of many extinct forms of animals, including those of elephant, rhinoceros, hyena and bear. The news of these discoveries inspired an English clergyman, Dean William Buckland, at that time also Reader in Geology in the University of Oxford, to investigate the Paviland cave on the Welsh coast. It was not long before Buckland made one of the notable discoveries of the century.

The Paviland cave is set in a limestone cliff and soon yielded a store of prehistoric treasures. Flint implements, as well as ornaments and tools of bone and ivory, lay embedded with the same species of extinct animal which had been found in the stratified caves of Germany. With them Buckland discovered a human skeleton, stained with red ochre. This became popularly known as "The Red Lady of Paviland", though it was later found to be that of a young man.

The problem of interpreting his discovery placed Buckland in a difficult position. As a geologist, he suspected that he had found the remains of a "pre-diluvial man". As a Christian minister and a Diluvialist, the tenets of his faith precluded him from admitting it. In the end, he apparently allowed his conscience to dictate his pronouncement. He explained his discovery by suggesting that although the remains of the animals had probably been swept into the Paviland cave by flood waters, the human body must have been intrusively buried at a much later date, when man had settled in England long after "The Flood".

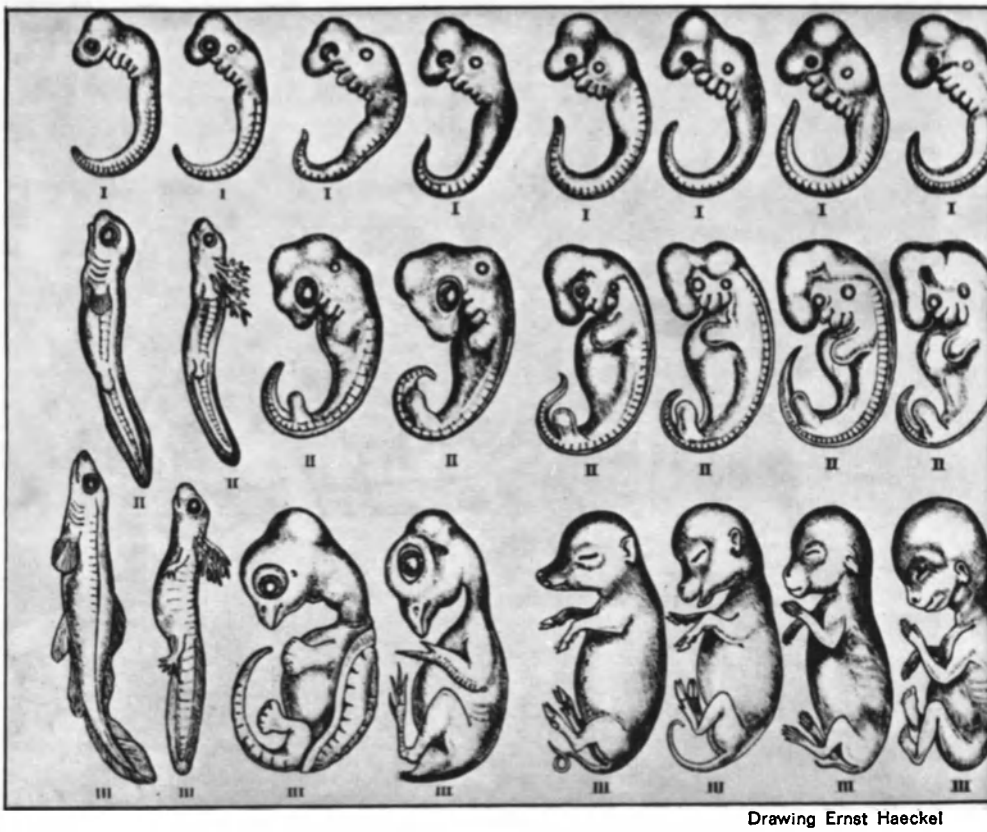
A few years later a Roman Catholic priest, the Reverend John MacEnery, began to investigate the huge rambling limestone cave on the Devon coast of England known as Kent's Cavern. He found man-made stone tools in association with the same species of extinct animals that Dean Buckland had uncovered in the Paviland cave; but unlike Buckland he did not allow his scientific judgment to be obscured by religious beliefs.

In spite of the severe criticisms to which he was subjected by the Church, and even by Buckland, Father MacEnery remained convinced that he had found sufficient evidence to maintain that man had lived in England long before the time of the "Biblical Flood", as a contemporary of the

CONTINUED NEXT PAGE

AN EARLY 'EVOLUTIONIST'

An early exponent of the doctrine of evolution was the German zoologist Ernst Haeckel (1843-1919). These drawings made by Haeckel himself in 1866—some of many he produced for books on biology—illustrate one example of his theory of recapitulation, i.e. if a land animal had ancestors which lived in water and used gills, each embryo of that animal continues to develop gills even though they may be lost during later embryonic development. They show (from left to right) fish, salamander, tortoise, bird, calf, pig, rabbit and human embryos. At first stage (top row) all have gill-like organs to the right of the eye. At second stage (centre) limbs develop but "gills" are still present. At third stage (bottom) physical differences are apparent and "gills" have disappeared in non-aquatic creatures.



Drawing Ernst Haeckel

The earth begins to yield up its secrets

extinct animals whose remains he had found. The notebooks in which he recorded his discoveries and interpretations were found and published many years after his death.

Meanwhile, the extensive limestone caves near Liège, in Belgium, had been attracting the attention of an intrepid and dedicated palaeontologist. In the course of his explorations, Dr Schmerling of Belgium investigated more than forty caves along the banks of the River Meuse and collected quantities of fossilized animal remains which were associated with implements of stone and bone. Human fossil remains were both fragmentary and scarce, but since he found them embedded in the same strata, Schmerling maintained, in spite of opposition, that all three groups were contemporary.

In 1833 he made the discovery for which he is famous. Day after day, month after month, he had been visiting a cave named Engis. His reward came at last with the discovery of an almost complete "primate" skull. It was embedded five feet within the breccia and surrounded by the remains of extinct forms of elephant, bear, tiger, hyena, rhinoceros, reindeer and other animals which had disappeared before the beginning of what was then accepted as the time boundary of the late Stone Age. In Schmerling's opinion, this was conclusive proof that man had been living in Europe "long before the Deluge".

Another discovery that was totally ignored during this period was made in 1848 in Gibraltar. This find, a well-preserved skull, was eventually brought to England in 1862, but it was not until the beginning of the twentieth century that its unique place in the history of human evolution was finally established. It represented, as we shall discover, the first recorded remains of Neanderthal man, whose history plays an important part in the story of man's evolution.

It was largely due to the brilliant and indefatigable work of a Frenchman, M. Boucher de Perthes, that the balance of scientific thought was finally tipped in favour of those who believed in the existence of "antediluvian man"

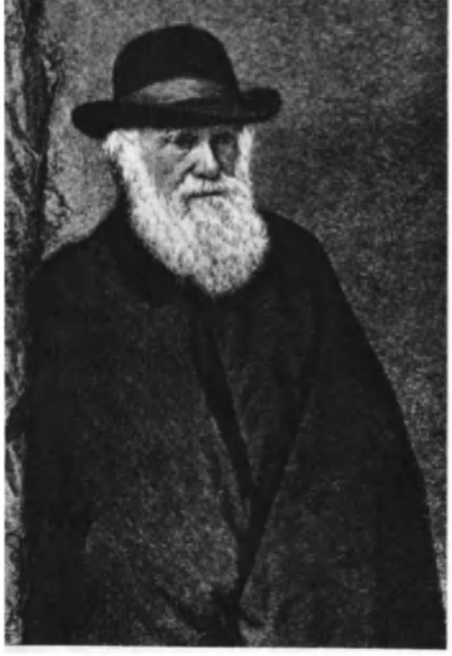
Boucher de Perthes was a lover of antiquities as well as a great scholar. In 1825, when he was about forty years old, he was appointed to the post of customs officer at Abbeville on the river Somme. The gravel beds in the valley of the Somme were continually being exploited for commercial purposes and had already been investigated and found to contain the fossil remains of extinct animals.

These gravel beds naturally attracted the attention of Boucher de Perthes, who soon began to notice that many curiously shaped stones were dug from the gravel by the workmen. In spite of the fact that the gravel beds had been assigned to the so-called prediluvial geological period, Boucher de Perthes was convinced that the stones, which he began to collect from the workmen, were in fact "stone tools" which had been made by man. He was sure that he had found positive proof of man's existence in Europe before "The Flood".

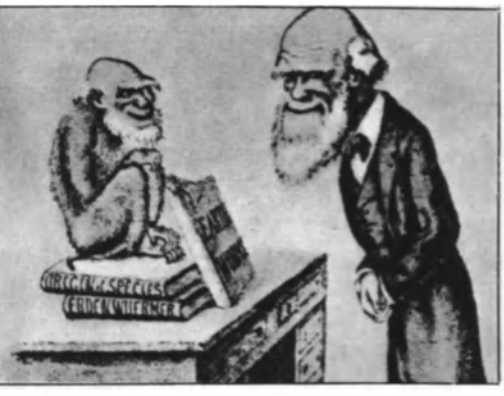
He claimed that the soils outside Abbeville contained stones worked by "antediluvial man", in association with the fossil remains of large animals belonging to extinct species. Boucher de Perthes began to be regarded by scientists as a dreamer and a visionary. The Church dubbed him a heretic. He does not appear to have had one single supporter of any authority until 1854, when he was visited by a Dr Rigollot, a physician from Amiens, whose scepticism about the age and authenticity of the "stone tools" from Abbeville was well known.

Having examined the Abbeville stone implements, Rigollot returned to Amiens and discovered that there were similar stones in comparable strata at St-Acheul near Amiens. Completely converted, Rigollot ranged himself enthusiastically on the side of the opponents of the diluvialist theory, and it is fitting that the work of these two pioneers of prehistory should be associated with two early cultures of the Stone Age known as the Chellean (or Abbevillian as it is now called), and the Acheulean.*

* *Chellean after the site at Chelles, Abbevillian after the site at Abbeville and Acheulean after St.Acheul.*



Portrait of Darwin, from "The Life and Letters of Charles Darwin", by Francis Darwin; John Murrary Ltd., London, 1887



Charles Darwin (1809-1882) is shown at left one year before his death. When he returned from his voyage in H.M.S. Beagle at the age of 27, he brought back with him specimens of the 13 types of finches (right) he found in the Galapagos which were to give him the clue to the relationship between variation and adaptation. The traditional idea of creation maintained that each of these 13 species had been separately created and never varied. Darwin assumed that since these species were fundamentally the same they were descended from a common ancestor and that the variations were due to adaptation to circumstances. Darwin was violently attacked from all sides after the publication of "On the Origin of Species". The 19th century cartoon, below left, published in Germany, carried the caption "Darwin in consultation with one of his ancestors."

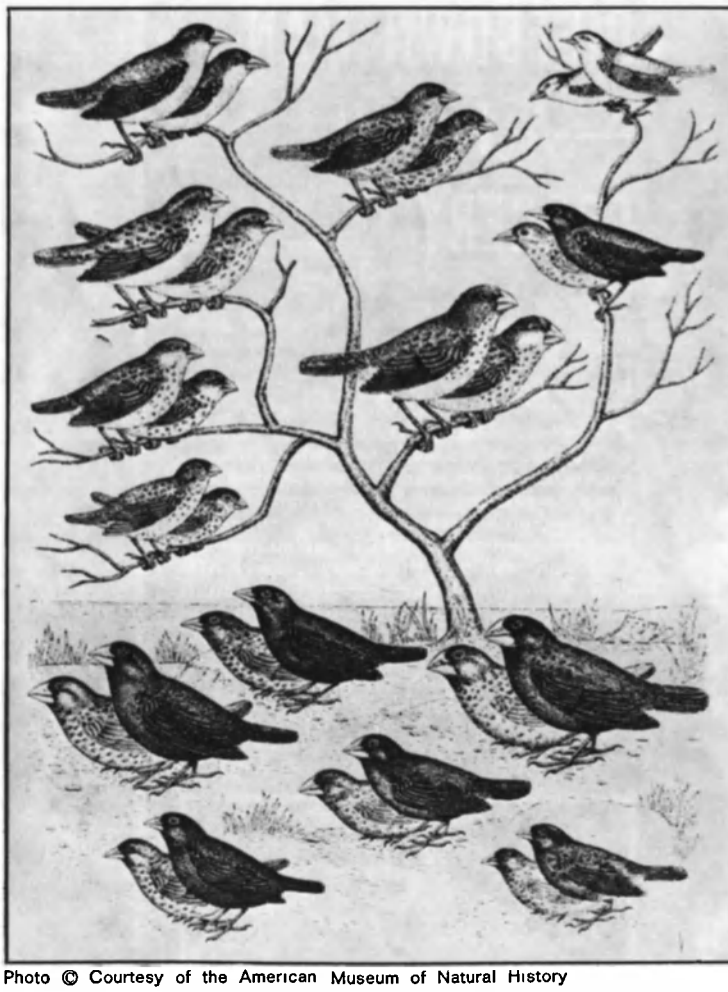


Photo © Courtesy of the American Museum of Natural History

We have already seen how the significance of a fossil human skull, found in a quarry in Gibraltar in 1848, went unrecognized. Nine years later, some workmen quarrying the limestone cliffs of a deep ravine near Düsseldorf in Germany made a similar remarkable discovery. The celebrated Neanderthal cave (which has long since been demolished), then opened half way up the steep side of the cliff and, in 1857, the remains of a strange individual were found buried beneath its floor.

By good fortune, a medical doctor, who was interested in fossils, recovered the remains of this skeleton from the workmen and sent them to an expert anatomist for examination. The extraordinary character of the skull presented many problems. These were made the more difficult and unhelpful because no other animal remains and no artifacts were found nearby. There was literally no associated clue to guide the scientists in their estimation of the antiquity of these human bones. The find aroused intense interest in scientific circles.

It is to Professor William King of Queen's College, Galway, in Ireland, that honour is due for being the first scientist to recognize that the skull cap from the Neanderthal cave belonged to a representative of a hitherto unrecognized type of mankind. Although the vault of the skull was the only well-preserved part of the fossil, King created a new species for its reception and named it *Homo neanderthalensis*.

Scientists of the time were not then ready to believe that the prehistoric world might have been peopled by different species of mankind. Many of them therefore continued to regard the Neanderthal skull as a pathological specimen. More than half a century was to elapse before King's opinion was endorsed by science and the famous skull from the Neanderthal cave accepted as representing a member of the species he had named *Homo neanderthalensis*.

The first half of the century was now almost over, and the stage was set for one of the most dramatic moments in the history of science. Lyell and other geologists of the period had pushed the story of our planet back in time, presenting mankind with a new and awe-inspiring concept of a world which was old beyond imagining.

Their research had revealed that great areas of land, now submerged by water, had once joined Asia to America, Europe to Africa, and Great Britain to the rest of Europe, so that in prehistoric times both men and animals could have wandered across these land bridges from one continent to another. Evidence had also been discovered to show that large parts of the world had once been frozen in the grip of a great glacial epoch.

In Switzerland, between two glacial deposits, geologists had found a bed of fossilized plants which could only have flourished in a temperate climate. This, together with an accumulation of additional data, led them to believe that there must have been both glacial and interglacial stages within the Great Ice Age.

From about 1850 on, the "Diluvial" theory rapidly lost ground. Not only was it untenable in the light of the new geological data which were coming to hand, but many scientists were beginning to wonder whether the Biblical "Flood" had, in fact, been a "Universal Deluge", or merely a local flood confined to the area in and around the Euphrates Valley, where Adam and all his descendants, including Noah, had reputedly lived.

Learned men throughout the ages have speculated upon the number and combination of species which Noah must have packed into his Ark. In the sixteenth century the famous Elizabethan sailor and explorer, Sir Walter Raleigh, calculated that there must have been "eighty-nine distinct species of beastes", but by the end of the eighteenth century this figure had been doubled, and the estimated proportions of the Ark had grown correspondingly formidable.

The problem was aggravated by evidence which had now come from such far-flung areas as Africa, Asia, America and Europe, that each con-

CONTINUED PAGE 65

PILTDOWN MAN —A FOSSIL FORGERY

In 1912, a British amateur geologist and antiquarian, Charles Dawson, reported the discovery first of parts of a skull and later of a jaw in a gravel pit at Piltdown in southern England, which when reconstructed proved to be a modern human cranium possessing an ape-like lower jaw. "Piltdown man", as the remains became known, which looked like a new kind of "missing link" between man and the apes, sparked off one of the longest and most sensational controversies in the study of prehistory. The remains were at first accepted as genuine by a few authorities, but it became increasingly difficult to reconcile the Piltdown man with other finds,

Photo © courtesy of The American Museum of Natural History

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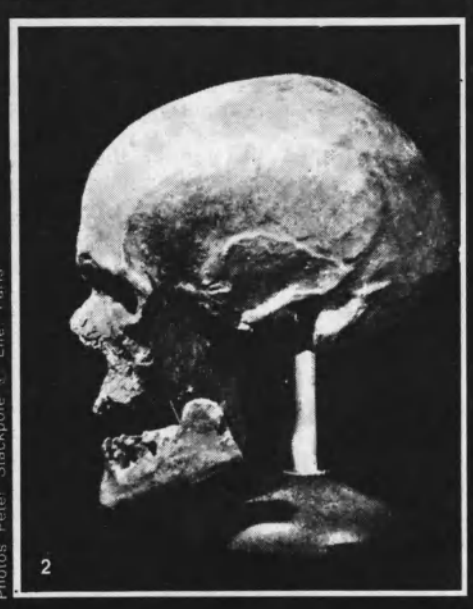

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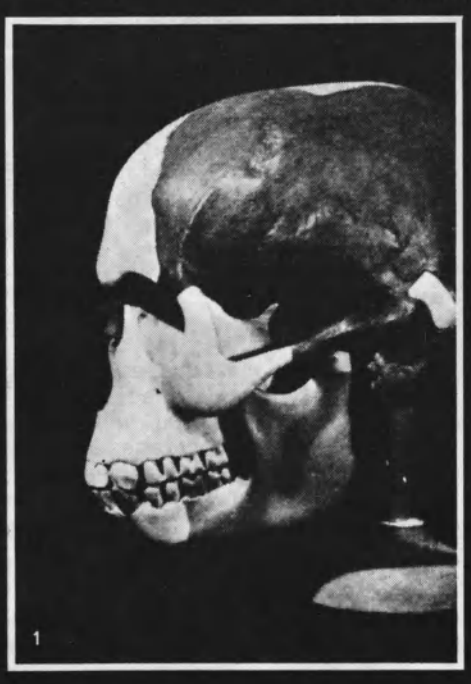

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such as Java man and the African premen which had more ape-like skulls and more man-like jaws. Finally, in 1953, special studies and tests proved unquestionably that the Piltdown skull fragments were a fraud—that they belonged to a modern man and the teeth and jaw to a modern ape. The material had been chemically treated and skilfully tampered with to make it appear ancient and authentic, and it had been planted in the gravel pit by an unidentified hoaxer. One theory is that the perpetrator aimed to embarrass the prehistorians of his time and undermine the entire idea of human evolution, still strongly challenged in many quarters. With modern scientific dating methods, no "fossil" like the Piltdown man would be likely to escape detection today. Above, Charles Dawson (standing right) and British scientists watch anatomist Sir Arthur Keith measure the Piltdown skull. The three skulls on left show, in clockwise order, first, the Piltdown skull, second a skull of modern man and third, the skull of Java man.

Photos Peter Stackpole © Life Paris

tinent had its own particular fauna. Forms ancestral to these animals had been found in geological deposits formed before the Biblical "Flood" could have taken place. Only by means of a miracle, therefore, could Noah have collected individuals from all the living species in the world before the "Flood" and redistributed them afterwards.

The controversy regarding the existence of man in Europe before the "Flood" now began to die away, and scientists concerned themselves with the chronology of glacial and interglacial man and his cultural remains. Now that the true significance of stone tools was appreciated, a vast wealth of data was beginning to accumulate about the social life and industries of our remote ancestors. A succession of classified cultures known as Stone Age, Bronze Age and finally Iron Age had by now been established.

Theories and ideas, suppressed for so long by religious prejudice, now struggled into the light, and were apparent in the new and rational approach which was being adopted in the search for man's origins. Many of the old beliefs which had been exaggerated by poetic fiction were therefore swept away.

Wherever the curiosity of man led him to investigate and chronicle the marvels of the natural world, scientists now found themselves in the possession of a vast storehouse of knowledge. It remained for someone to postulate a theory which would account for the diversity of life on earth and the ultimate miracle of mankind.

The idea of evolving life, which was so soon to capture the imagination of man, was not a new one. Until now, however, it had been stultified by the bigoted acceptance of the doctrine of special creation, which maintained that all species remained exactly as they were when first created. A handful of advanced thinkers of the late eighteenth century, such as Carl Linnaeus, the famous Swedish naturalist, Erasmus Darwin of England, and Lamarck of France, had put forward revolutionary ideas which were in opposition to the theory of immutability of species. It was, however, Charles Robert Darwin who finally gave the world a new concept of the animal kingdom.

Today Darwin's concept of evolution is so well known and so widely accepted that it is difficult to imagine the magnitude of the sensation it caused when it was published in 1859. The first edition of the book was sold out very quickly and the reaction to its doctrines was immediate.

The Church saw it as a threat to the very foundations on which the doctrine of special creation and the literal belief in Biblical chronology had been built. It therefore attacked Darwin with an almost fanatical intensity. The idea that a wise and powerful God had designed and created all living things in a permanent immutable form, was part of the Christian faith. Many scientists, while recognizing the genius of a theory which would withstand the most acid tests of logic, nevertheless turned from the idea of the mutability of species on purely religious grounds.

Darwin himself was emotionally involved in the conflict which his theory of evolution had provoked, and he always stressed that he had not been motivated by any anti-theological bias when he wrote the *Origin of Species*. For those who came to accept Darwin's theory, man began to be regarded as the ultimate triumph of a process of evolution which was even more miraculous and awe-inspiring than was the concept of a special creation of each separate form of life.

Louis S. B. Leakey and Vanne Morris Goodall

THE PUZZLE OF PEKING MAN *(Continued from page 56)*

In the course of this operation the workmen discovered under the sediment, at the top of the hill, a well preserved cave, which became known as the Upper Cave. It had been used as a refuge by animals and by men. Human remains, including three well-preserved skulls of a much more recent period than *Sinanthropus*, were mixed with fossilized skeletons of hyenas, bears, wild goats, tigers and stags, and ostrich and civet bones. Amid all this confusion lay evidence of a quite different culture, fairly close to the neolithic—pierced teeth and shells, more finely fashioned stone, bone necklaces and polished stag antlers.

One very important fact emerged. A close study of this material and a comparison of it with that found at lower Choukoutien and the Ordos desert revealed a number of affinities and resemblances. Perhaps this was due to the similar nature of the stone raw material found on these sites: quartz, hyaline, silicified limestone and chalcedony, as well as pebbles used for hammering.

Nevertheless, the man of the Upper Cave, more advanced and a better workman, had found a way of piercing shells, teeth and even stones with which to make necklaces, and the ornaments were always found in the immediate vicinity of the skulls. The industry of the Upper Cave belongs to the close of the Palaeolithic era; we are now at the beginnings of the advanced era of shaped stone, the Neolithic era.

Thus the discoveries made in the Ordos desert in 1923 took on new meaning. The heterogeneous stone industry uncovered by Licent and Teilhard was probably the work of men of differing races, brought to this place by migratory waves. It has links with Mousterian, Aurignac and Magdalenian industry. The man or men of Ordos fill an intermediary position between the two fossil forms found near Peking.

Prehistoric men, one group as old as *Pithecanthropus*, the other more recent, *Homo sapiens*, inhabited the Choukoutien site, using, at an interval of some tens of thousands of years, the same raw materials for their industry—a primitive industry of uneven yet also inestimable value to the anthropologist, having specific, distinctive characteristics readily detectable to specialists.

As far as the bone industry of the *Sinanthropus* period is concerned, although it was positively identified and defended by Abbé Breuil, it remains a subject of controversy to this day.

The friendly, scientific quarrel between Teilhard and Abbé Breuil was never finally resolved, each of them maintaining his own position. Was this necessarily a bad thing? I do not think so. It shows us how far a scrupulous study of facts can leave men of science divided when they are convinced that their reasoning is rigorously objective.

Although, as far as I know, Abbé Breuil never went back on his opinion, he nevertheless sided with the specialists. Like them he saw in *Sinanthropus* a representative of a race of men in the full sense of the word, that is to say, capable of handling fire and making use of quartz and pebbles in a way essential for his survival. What he did not accept was that *all* the stone and bone tools found in the Choukoutien layer were made by *Sinanthropus*.

Let us hope that today's Chinese geologists and anthropologists will reap as rich a harvest as their predecessors and that, one day, they will give us the long-awaited answer.

Pierre Leroy

The name of Mikhail Gerasimov is now internationally famous for his reconstructions of the faces of historic world personalities (here three stages in reconstructing the face of the great 14th century conqueror, Tamerlane), which led to his revolutionary work in the reconstruction of the features of prehistoric man.

THE FACE-MAKERS

by Mikhail Gerasimov

CURIOSITY about the past is an enduring characteristic of mankind, and interest in our predecessors is not limited to the hard facts of what they achieved and how they lived; equally intriguing is the question of what they looked like.

Improved scientific methods of creating anthropological portraits from skulls, developed over the past few decades, have enabled us to reconstruct the likenesses of such legendary figures of the past as Ivan the Terrible and Tamerlane (see photos below). These methods have also made it possible to authenticate disputed human remains, as, for example, in the case of the puzzle of the two skulls of the German poet Friedrich Schiller (see photo story page 68).

With historical figures such as these, records and descriptions exist by means of which we can check the accuracy of our reconstructions, but the task is not so easy when we attempt to create anthropological portraits of our prehistoric ancestors.

The first attempts to reproduce the outward appearance of early man were made during the last decades of the 19th century. Anatomists had established certain links between the shape of the skull and the flesh and muscles of the face. Such men as Professor Schaffhausen of Germany and Professor Kohlman of Switzerland were pioneers in this field and during the first half of this century several anatomists and anthropologists, sometimes with the help of artists and sculptors, attempted to reproduce the features of our early ancestors.

However, reconstructions made by different people of the same Neanderthal skull from La Chapelle-aux-Saints, in France, were so varied that it was clear that the methods used were inadequate. A big step forward was made by the French anthropologist Marcellin Boule who reconstructed the basic muscles of the face, neck and torso on the assembled Neanderthal skeleton from La Chapelle, creating a figure with the characteristically stooped spine, the short, forward-thrusting neck and protruding head.

I had been interested in this problem ever since I was a schoolboy and realized that before creating a portrait of prehistoric man we first had to learn how to reproduce the appearance of contemporary man. For ten years I carried out research into the techniques for reproducing faces from skulls and, in 1937, I was able to formulate a method which has proved itself over more than thirty years and has even been used by criminologists to identify unknown persons.

Historical problems too were resolved by these methods. Why, for example, were Tamerlane and his son Shahruh of different anthropological types? Tamerlane's skull is Mongoloid, while Shahruh's is Europoid. Proof of the blood relationship between Tamerlane and his descendants—Shahruh, Mironshah, Ulug-Beg and Mohammed-Sultan—was provided by the morphology of their skulls; they all possessed the same asymmetrical form which could only be explained by heredity. Shahruh, however, inherited his Europoid features from his Tadjik mother.

When the family sepulchre of Ivan the Terrible was opened in 1963 there was considerable doubt as to the authenticity of the skeletons found. The reconstructions I made corresponded perfectly with contemporary portraits of the Tsar (the right eye smaller than the left, the heavy chin, the protruding lower lip, which combined to give him his "terrible" appearance) and of his son (an insignificant, harmless bald-head).

I was also able to identify with certainty the skull of the 11th

Photos M. Uspensky © APN, Moscow

Photo V. Shandrin © APN, Moscow

MIKHAIL GERASIMOV *is shown at right working on the reconstruction of the face of an ancient skull in the Laboratory of Plastic Reconstruction at the Institute of Ethnography of the U.S.S.R. Academy of Sciences, in Moscow, of which he was director until his death in 1970. A special exhibition of his famous reconstructions of prehistoric man was displayed at Unesco House in Paris in 1969.*

century poet Rudaki; the eye orbits of his skull showed signs of atrophy resulting from the blindness with which he is known to have been afflicted.

The comprehensive study of modern man by anatomical and anthropological methods, by X-Rays and photographs of living persons, provided a great deal of information about the complex relationship between the structure of the muscles and soft integument of the head and face and the skull. In the case of prehistoric man the skull, of course, is the only thing we have to go by.

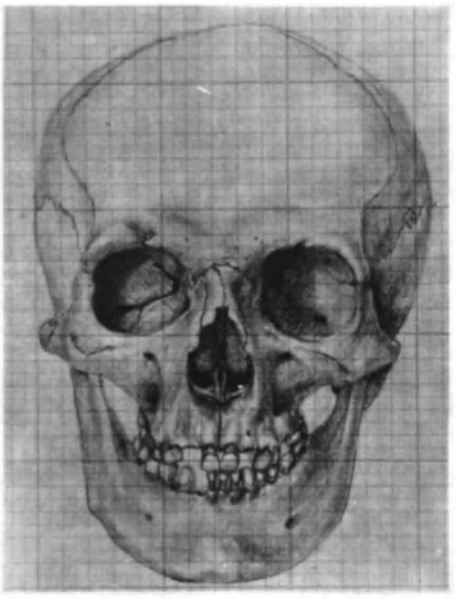
The individual features of man are determined by the proportion, size and shape of the skull, its asymmetry, the degree of relief development, the structure of the surface, the vertical and horizontal profiles, the structure of the nasal bones, size and shape of the teeth, their bite, the size and shape of the eye orbits. The thickness of the soft tissue depends upon the degree of development of the relief of the skull. As a rule, very ancient hominids possess fairly strong reliefs and this is taken into account in reconstructing their features, but the same methods and techniques are employed in reproducing the likenesses of both prehistoric and modern men.

I began working on a portrait of prehistoric man in 1937 and we now have an entire gallery of portraits showing man's evolution from the Lower to the Upper Palaeolithic period.

Reconstructions made from the skulls of ancient forms of men, such as "Pithecanthropus" and "Sinanthropus", give clear evidence of the wide range of morphological variations and the complexity of human evolution. Study of early Neanderthaloids and of classic Neanderthals, helps us to understand the mechanisms which led to the beginnings and the development of early "sapiens" forms. ■

THE TWO SKULLS OF FRIEDRICH SCHILLER

When the German poet Friedrich Schiller died, in 1805, two deathmasks were made, one in plaster and one in terra-cotta, and a portrait drawn by Professor Jagelmann (Photo No. 5). In 1826, a skull (Photo No. 1) and skeleton were exhumed from the communal grave in which Schiller had been buried and identified by his children, by Goethe and by Schwabe as Schiller's. Later serious doubts were raised and it was said that the skull was not Schiller's. In 1911 an anatomist, Froriep, found another skull (Photo No. 3) in the same common grave which he claimed was the true Schiller skull. In 1961, the German Academy of Sciences in Berlin asked Professor Gerasimov to use his technique of plastic reconstruction to determine which of the two skulls was authentic. Photo No. 2 shows (a) Gerasimov's reconstruction of the profile of the skull in Photo No. 3 superimposed on (b) a silhouette in black of the profile of the skull in Photo No. 1. Photo No. 4 shows Gerasimov's reconstruction of the 1826 skull (Photo No. 1) which confirms that this skull, recognized by Schiller's children, Goethe and Schwabe, was indeed authentic.



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4

Photos M. Uspensky © APN, Moscow

5

The man from La Chapelle

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4

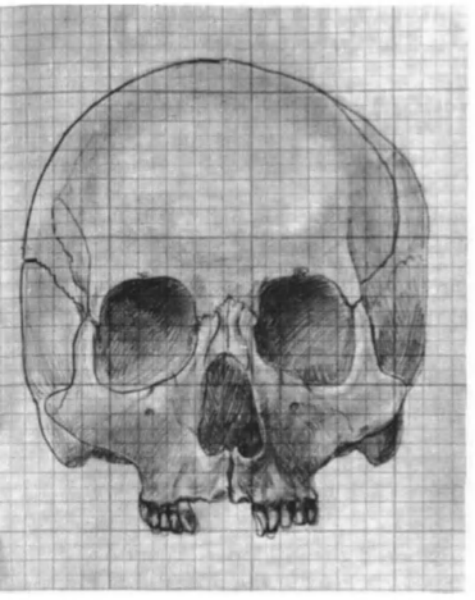
2

Photos M. Uspensky © APN, Moscow

Early attempts to reconstruct the features of a Neanderthal man, whose skull (Photo No. 3) was found at La Chapelle aux Saints, France, were based on imperfect methods and bore little resemblance to each other (Photos Nos. 1, 2). The reconstruction (Photo

MAN, THE FIRST WALKIE-TALKIE

Continued from page 58



3

5

1

No. 4) by the French anthropologist Marcellin Boule, made more scientifically by building up the basic muscles of the head, neck and torso on the assembled skeleton, shows considerable similarity to Professor Gerasimov's reconstruction (Photo No. 5).

giving the same record on an electromyograph (a recording of muscular vibrations) as for spoken words. So the communication of information and the formation of concepts supplement and control each other.

The combination of percepts in concepts and the expression of their symbol, the word, has become a function of the speech organs because no other human organ can respond with such versatility, accuracy and speed to impulses from the cortex, without an excessive expenditure of energy and without interfering with any other motor activities.

Modern man can pronounce hundreds of syllables a minute, each of which requires a different use of the vocal chords, a different direction of air expelled from the lungs and a different positioning of the tongue and the mouth cavity. The whole system of articulation can switch from one position to the next in a fraction of a second.

This mobility of the speech organs and the extremely flexible link-up of concepts are the result of a long evolution. To trace the steps in this evolution scientists have studied the different stages of man's increasingly complex mental activity, the structure of jaws and other parts of skeletons in fossilized apes and hominids, and the stone tools of prehistoric men.

No fossil records have been discovered of the first hominids who systematically used stones and sticks. The cut stones of the Olduvai culture (1.7 million years ago) show that to give a stone a pointed tip, the craftsmen of that period chipped off several irregularly-spaced pieces of different sizes, which suggests that the Olduvai hominids were at an intermediary stage between concrete percepts and concepts, or what are known as "general percepts".

Their vocal activity probably also belonged to an intermediate stage. They inherited from their animal ancestors audible signals consisting of single sounds, but instead of reproducing these sounds automatically they were already able to select them to a certain extent.

The earliest hominids had already mastered the art of making articulated sounds and combining them in different ways to form syllables, which initially remained unchanged. This early form of articulate speech is called the "lalia" stage (from the Greek word meaning to chatter or prattle).

Lalias were not used to exchange ideas or converse, but to stimulate actions or to signal some important event in the life of the group. They were monosyllables with many meanings and of course had no grammatical structure. Yet they possessed all the basic properties of this type of speech: fixed enunciation of separate sounds and their combination into syllables. (The capacity to combine syllables and words did not come until much later.)

Substantial progress in the development of speech is indicated by the shaped stones of the Acheulean culture, which emerged some 200,000 years ago. These were implements of a definite form with regular facets cut all over the surface. To make a primitive chopper it had been enough to remember a sequence of four or five blows, but to shape the Acheulean implements the craftsman had initially to have a clear idea both of the desired final shape and of the sequence of blows and other actions needed to produce it.

The Acheulean implements reveal a varied and flexible combination of percepts corresponding to the conceptual stage of mental activity, though naturally in rudimentary form, without any clear-cut distinctions between individual percepts. True thought becomes possible only when there is a free combination of at least two independent elements: the percept of the action and that of the object or subject of the action; at the previous stage both aspects are fused.

Along with the flexible combination of separate percepts, the Acheulean hominids mastered the free combination of syllables, forming words. Their fossilized remains show that they possessed a larger brain than the earlier forms, as well as a less massive and shorter mandible. Because of this shortening of the lower jaw, the root of the tongue was lower and the position of the larynx was altered, which meant that the air current was no longer directed straight at the lips, but had now to overcome various barriers, notably the tongue.

The first words, still few and mainly monosyllabic, related to material objects and basic facts in the lives of primitive peoples, particularly their food-gathering, and perhaps some percepts with a magical meaning. New words were formed by doubling or inverting syllables or by changes in the pitch of some sounds. First mastered by one or several members

CONTINUED NEXT PAGE

of a group, they were adopted by the group as a whole if they supplied a need, and then modified by practical use.

During the later Stone Age, the paleoanthropes or Neanderthal men gradually enriched their vocabulary, but their intellectual faculties and speech seem to have remained on the same level of isolated words. A major change took place at the end of the Stone Age, at the time of the fourth and final glacial period, when the direct ancestors of modern man, *(Homo sapiens)*, appeared, some 50,000 to 30,000 years ago.

The brains of these early men were about the same size as those of their predecessors, but their skull had a higher vault and more rounded forms, especially the forehead and the back of the head. The lower jaw was smaller, and the area of the muscle attachment was also reduced, aiding rapid articulation. The muscle attachments inside the lower jaw were also similar to those of modern man, while the bone on the outside had grown forward to form a chin.

These Neolithic men had made remarkable progress in stone-cutting techniques. More elaborate implements of many kinds were made, including bone articles and even needles. Ornamentation, sculpture, drawing and painting were also widely developed. The main occupation of these men was, of course, hunting wild animals.

So far as their technology, economy and arts were concerned, these people of the last glacial period in Europe had a standard of living and way of life that were by no means inferior to those of certain hunting and food-gathering tribes still existing today. There is no doubt that they were able to form paired combinations of concepts and words (relating an action to the object of the action). In other words, they had fully mastered articulate speech.

The emergence of Neolithic man with his combination of separate words with different meanings ends the history of the origins of speech as a general human trait. The periods that followed saw the elaboration of different speech systems or languages with their own phonetic, lexical and grammatical structures.

According to historical, archaeological and linguistic research, the great basic language systems emerged in the early Age of Metals some 6,000 to 9,000 years ago, while the formation of many contemporary languages dates from historical times.

Victor Bunak

10 MAJOR CONCLUSIONS

on the origin of Homo sapiens

1. Recent discoveries have upset the long-accepted time scale which showed a modern type of man emerging at around 35,000 B.C. These discoveries indicate the existence of men apparently of a modern type, not Neanderthals, over 60,000 years ago. These men existed in Europe as well as in Africa, the Middle East and perhaps Asia.

2. The Mousterian culture, so called from artifacts found at Le Moustier in south-west France and dated to between 90,000 and 35,000 years B.C., was formerly closely linked by anthropologists to Neanderthal man. But Mousterian type artifacts have been found at such places as Qafzeh, in Israel, and were not the work of Neanderthals but of a modern type of man.

3. Prehistoric tools, etc., of a type considered to be Upper Palaeolithic, a period formerly dated from 35,000 B.C. to 9,000 B.C., have been found in Cyrenaica and Poland and shown, by carbon 14 dating methods, to date from 38,000 B.C., that is overlapping the period of Neanderthal man.

4. It therefore seems certain that modern type men and Neanderthals coexisted for a number of years and that Upper Palaeolithic and Mousterian cultures overlapped in time.

5. The transition from Middle to Upper Palaeolithic seems to have occurred in a number of regions. Perhaps a proportion of the Neanderthal population evolved to something nearer to modern man and there may have been groups of modern type men in various places whose stone industry was Mousterian to start with and later progressed to Upper Palaeolithic. This is called the "polycentric" theory.

6. Anthropologists now seem to accept as definite that the classic European Neanderthal man of the type found at La Chapelle-aux-Saints, in France, must be excluded from the direct ancestry of modern man.

7. It also now seems to be accepted that certain characteristics of "modern" man appeared separately or in various combinations at widely different geographical points and at differing points on the time scale. Fossil remains recently found at Omo, in Africa, for example, support this view.

8. At the present stage of research a number of hypotheses about the origins of modern man are possible.

■ According to conventional theory, "modern" man evolved in a vast area comprising eastern Europe and western Asia from a non-specialized form of Neanderthaloid man. This theory is known as "diffuse monocentrism".

■ Dr. Leakey, however, suggests that a split occurred in the genus "Homo" in the Lower Pleistocene period (some 2-3 million years ago) with "Pithecanthropus" and Neanderthal man.

■ The majority of the anthropologists attending the Unesco Symposium accept the view that polycentric evolution is the most likely explanation for the occurrence of fossil human populations at different times and places. It is not, however, maintained that all lines of descent contributed directly to the evolution of present forms of man.

9. Proof that the early types of "modern" man and Neanderthaloid types are not different species may perhaps be found in the discovery in the Middle East of intermediary types, perhaps resulting from cross-breeding. (Thoma's theory).

10. Some anthropologists accept the idea that variations in environment and climate played an important part in the physical and cultural evolution of man in regions of extreme climate. Others maintain that physical evolution was determined by culture rather than by environment. ■

— Condensed from "The Origin of Homo sapiens" published by Unesco, 1972.

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The hunter and bison of Lascaux

With its walls and ceilings covered by a vast panorama of coloured paintings, the Lascaux cave in south-west France, discovered in 1940, is a veritable "cathedral" of prehistoric art. Air exhaled by thousands of visitors speeded up erosion of the limestone walls, and the caves, closed to the public in 1963, are unlikely to be reopened in the foreseeable future. In this remarkable hunting scene, a wounded bison with a spear through its body (not shown here) rushes furiously towards a stick-figure man lying on the ground. Below the man is a mysterious bird-headed stick. Authorities are not always agreed on the symbolic meaning of such Palaeolithic cave art, but its richness and variety help to convey something of the culture, thoughts and beliefs of men who lived some 15 000 years ago.